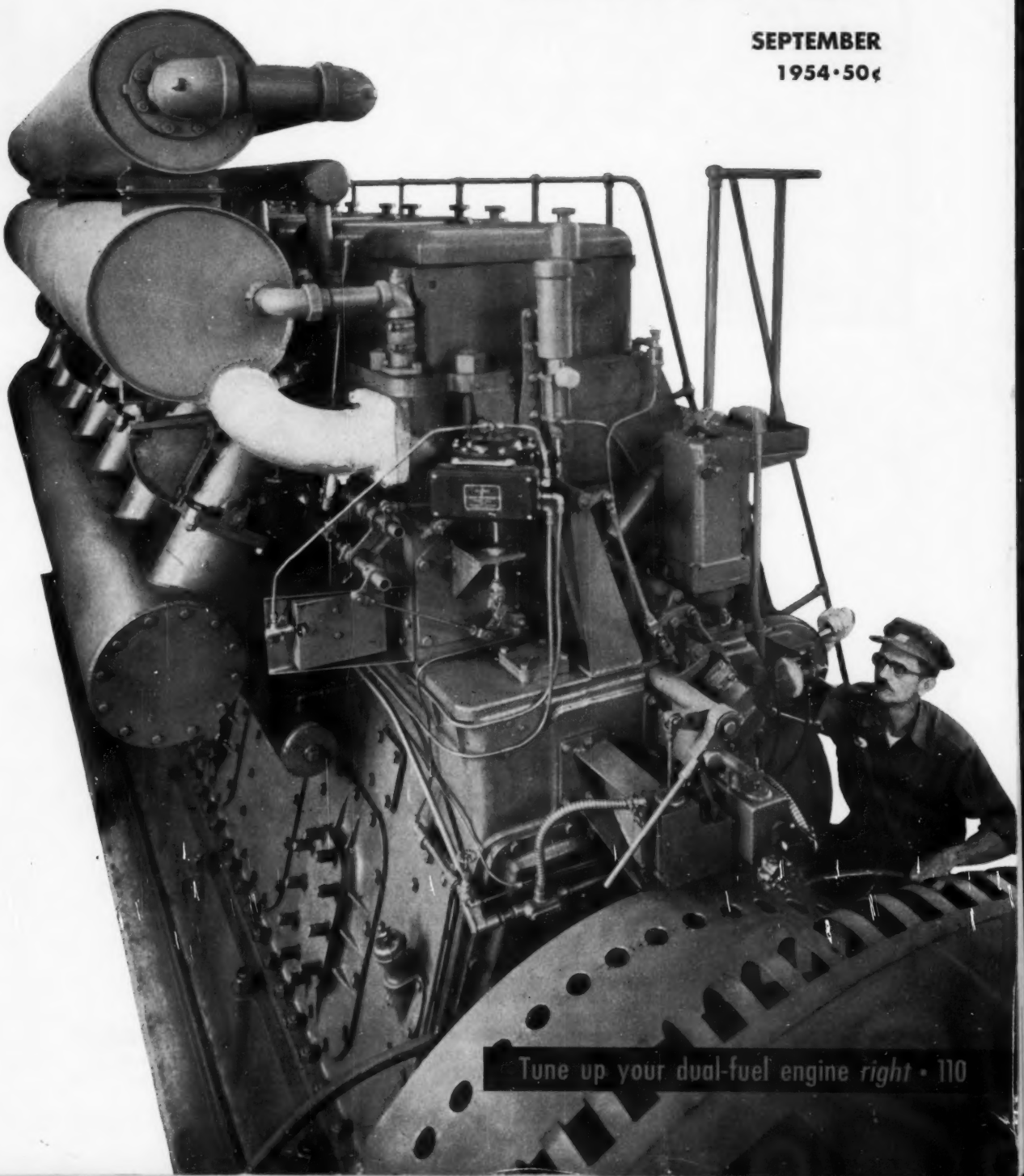
GENERATION, TRA ATION OF THE POWER SERVICES • A McGRAW-HILL PUBLICATION

FIRST SUPERPRESSURE UNIT designing its steam generator • 73

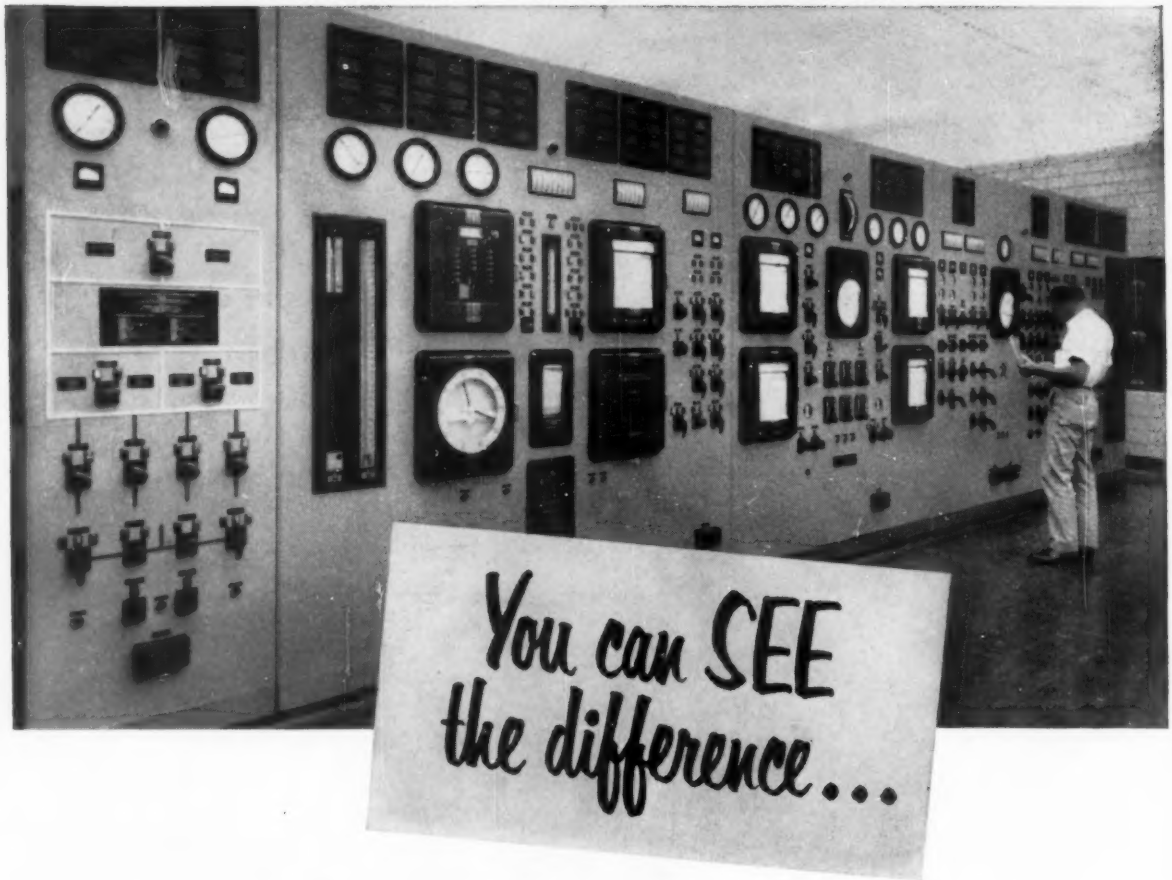
Power

Paid circulation: over 45,000

SEPTEMBER
1954•50¢



Tune up your dual-fuel engine *right* • 110



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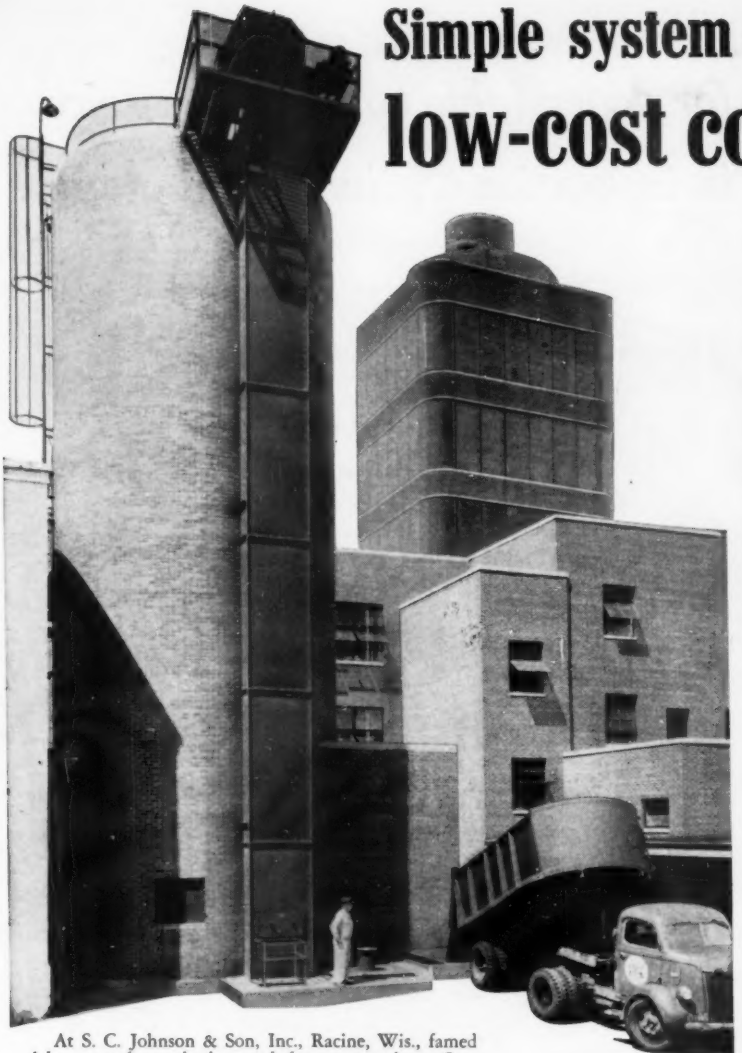
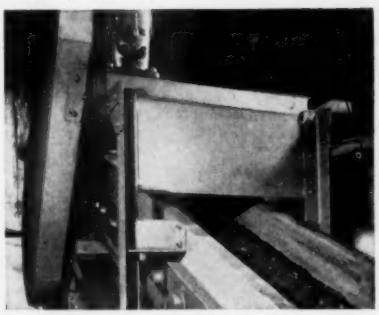
instruments automatic controls • furnaces

Simple system spells low-cost coal handling for small power plant

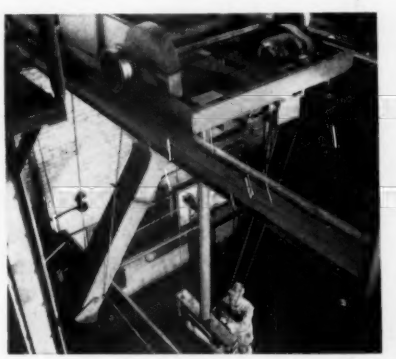


At S. C. Johnson & Son, Inc., Racine, Wis., famed laboratory forms background for power plant. Centrifugal discharge bucket elevator handles 40 tph.



Apron conveyor loads bucket elevator. Live or dead storage is fed by elevator.

From elevator, coal is moved by 12 in. screw conveyor atop storage silo.



Weigh larry delivers coal from discharge chute to three stoker hoppers.

LINK-BELT equipment at S. C. Johnson & Son, Inc. provides clean, efficient operation

THE compact, economical coal handling provided for the makers of Johnson's wax is typical of hundreds of Link-Belt power plant installations. Large or small — your plant, too, can get the added efficiency of modern, mechanized equipment.

Link-Belt's experience is based on years of success in meeting every type of coal handling problem. This vast background, combined with a complete line of coal handling equipment, is your assurance of a system that's right for your needs. And Link-Belt's quality products have earned a reputation for dependable, long-life service. See your nearest Link-Belt office for a copy of Book 2410, showing many typical, modern power plant layouts.

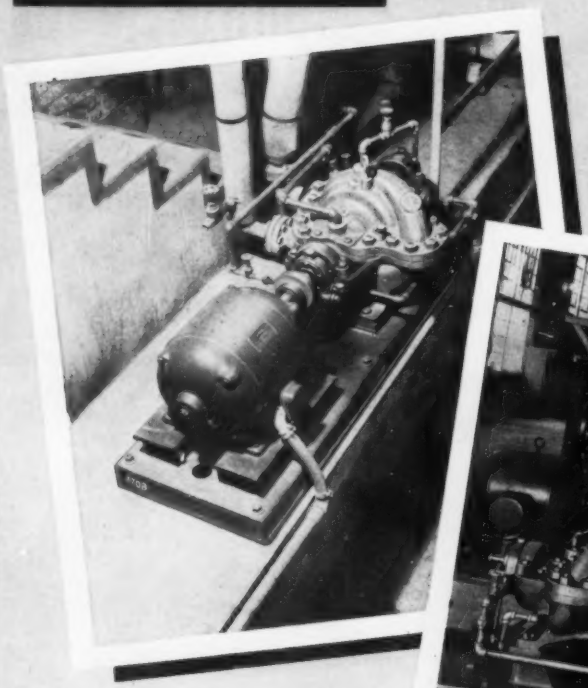
LINK-BELT

COAL HANDLING EQUIPMENT

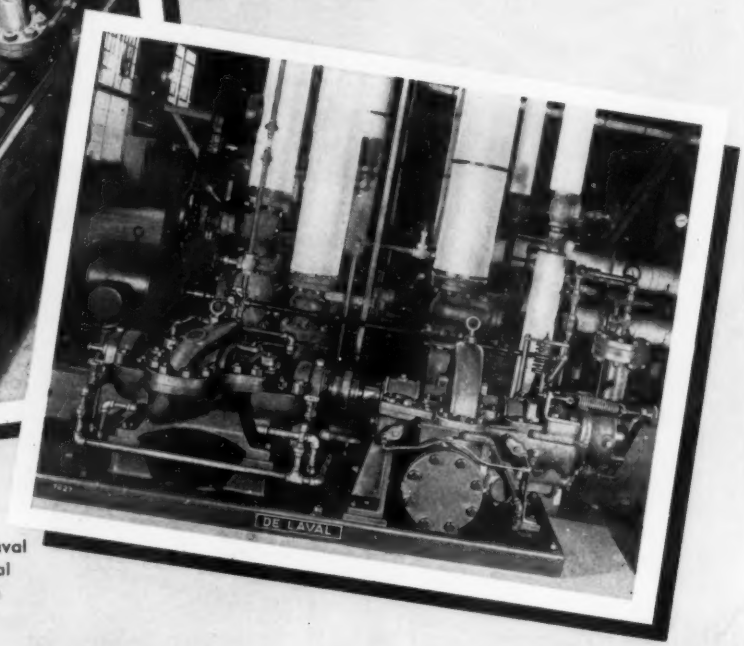
LINK-BELT COMPANY: Plants: Chicago, Indianapolis, Philadelphia, Colmar, Pa., Atlanta, Houston, Minneapolis, San Francisco, Los Angeles, Seattle; Scarboro, Toronto and Elmira, Ont. (Canada); Springs (South Africa); Sydney (Australia). Sales Offices in Principal Cities. 13,339

DE LAVAL
TWO-STAGE HORIZONTAL PUMPS

for dependable boiler feed service in institutions . . . industrial plants



Institutions can't afford shutdowns. In this hospital installation a motor-driven 2IS boiler feed pump provides year-in, year-out dependability. It delivers 70 gpm of 240° water at 420 ft. head.



Industrial plants, too, choose reliable De Laval pumps for boiler feed service. This De Laval unit, driven by a De Laval turbine, delivers 160 gpm of 215° water at 520 ft. head.

There are good reasons why De Laval 2IS-2KS two-stage horizontal split case pumps give long, economical boiler feed service. They are designed with • back-to-back impellers for balanced hydraulic thrust • easily replaceable threaded impeller wearing rings • long life labyrinth case rings • ring oiled ball bearings — plus ten other important design features.

These De Laval pumps are available in sizes from 2" to 8" discharge, for capacities from 75 to 3,000 gpm and heads to 750 ft.

Write for Bulletin 1501 giving complete data.

DE LAVAL *Boiler Feed Pumps*

DE LAVAL STEAM TURBINE COMPANY

815 Nottingham Way, Trenton 2, New Jersey

DL-27A

Power

SEPTEMBER 1954 • VOLUME 98 NUMBER 9

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Print order this issue: 47,352

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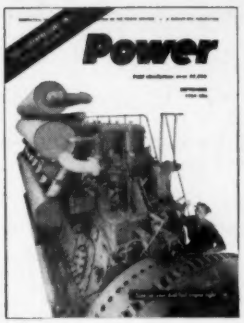
POWER articles are indexed in both the *Industrial Arts Index* and the *Engineering Index*. POWER publishes its own annual index.



DUAL-FUEL ENGINES, like the one at the Clyde, Ohio municipal plant pictured on the cover, have come a long way since POWER ran a pioneer article on their development back in May 1945. Now we're pioneering again, but in a different way, as befits the present wide acceptance of this versatile prime mover. This time we bring you what we consider the most complete step-by-step photo story ever run on tuning up an engine—whether dual-fuel or any other type.

This Operators' Notebook (pp 110-117) should hit the spot with anyone responsible for diesels. And even if you don't work with them, the eight pages of photos and captions will help increase your familiarity with these important power units.

Next month . . .

■ PUMPS, the latest in our handbook series, brings you a complete roundup on the centrifugal, rotary and reciprocating types that are the work horses in all industries.

Knowing Associate Editor Ty Hicks and his knack of clarifying technical details, we're willing to stick the editorial neck way out and bet you'll rate this one "tops."

■ Water-treatment problems in refineries can be pretty tricky, but the answers hold good across the board, as you'll learn from Vince Calise's informative October article on this subject.

■ Whether you're planning to revamp your electrical setup, or build a new one, you'll want to review the important facts about neutral grounding. An upcoming piece on the *how* and *why* of grounding generator neutrals does just that for you, so don't miss it.

. . . and future months

■ On the fire right now are plans and preliminary layouts for December's special report. It will deal with an unusual subject—one of untold importance and concern to all of you in the power-service field. Watch for details in the pages of forthcoming issues of POWER.

For an important announcement, turn page

ON PAGE 69 of this issue you will find the formal announcement that POWER has a new Editor. I hope all will read that notice because this change in the administration of your magazine is a rare event and not without significance.

Probably no other product is so dependent on teamwork and combined effort as a magazine. And yet it is equally true that few other products are stamped so strongly with the mark of a single man—its Editor.

So, on these pages, I have asked their staff partners to tell you something about Phil Swain, who retires, and Lou Rowley, who succeeds him. Here are their professional records and, because they are first of all very human beings, something of their personalities.

Shelton Fisher, *Publisher*

September 1954: Swain retires as editor...

► "FRED LOW wants a man who can put engineering facts into plain talk." The speaker was James H McGraw, Sr, pioneer publisher of POWER. Low was the Editor who had built POWER into a national institution.

Sitting on the other side of the big desk on that morning in 1921, Phil Swain, fresh in the big city from a colorful background as machinist, college teacher, army officer and field engineer, sensed a challenge. On June 1 he went to work as Assistant Editor of POWER and so started a career of plain talk to engineers that has extended for a third of a century.

If you asked him today, as he retires from the editorship of POWER, Phil might say he is a "reformed highbrow"—or maybe a tinker with an interest in science and teaching. Or he might describe himself as a man who loves machinery and likes to talk about it. To his associates Swain is, in fact, a bit of all these—a jack of all trades who has mastered several, those of machinist, teacher, engineer and editor.

Phil Swain's interest in science and mechanics began when he was in knee pants. After school in Laconia, N.H. he could be seen poking around mill junk piles seeking rusty shafts and pulleys for his latest project. Every summer he sweated for 60 hours a week in Huse's machine shop to earn mechanical know-how plus six dollars on Saturday night. Nobody knows where he picked up his knack of self-expression. It's rumored—but hard to believe—that he was a silent, bashful youth.

Be that as it may, Phil Swain, in 33 years on POWER, 20 as Editor, has hired and trained a team of topnotch engineer-journalists. Fired by his zeal for plain talk and clear pictures, they work endlessly to cut the gobbledygook out of technology.

Yet Swain has no use for half-baked journalism, has been equally insistent that each editor know his engineering right down to the ground. His personal contribution to this pool of knowledge has been a solid grasp of basic engineering science plus the finger-tip tool sense of the practical mechanic.

For the record, here are a few cold facts: Born in Westerville, Ohio, Aug 26, 1889. Grew up in New England. A college career extending over ten years. Finished liberal arts in 1911 (AB, Syracuse); specialized in physics and math. Yale gave him his PhB in 1913 and ME in 1915. He then taught heat power at Yale for two years. Every summer he picked up practical experience—in machine shops, boiler testing, research, construction.

Then came two years in World War I, including service in France as an artillery officer. Finally, two years of field engineering before joining POWER in 1921.

Swain's honors include Doctor of Engineering (Case), Fellow of the American Society of Mechanical Engineers, Sigma Xi (honorary scientific), Tau Beta Pi (honorary engineering). He is a registered professional engineer and a member of various engineering, social, civic and publishing organizations.

Now freed from operating responsibilities, Phil Swain plans a long vacation each summer to cultivate his hobbies of cruising and navigation. Meanwhile, as consultant to POWER and McGraw-Hill for nine months each year he will mix some business with his pleasure and continue to contribute an ever-youthful viewpoint.

Power

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...Rowley is appointed

► WHENEVER Lou Rowley looks backward, which isn't often, he confesses to mild amazement at the way the pieces of his life have, one by one, fallen into the exact pattern he would have chosen.

Back in 1931, he'd just completed eight solid years of engineering education—first at Brooklyn Technical High School and then at Polytechnic Institute (ME). He was rubbing shoulders with the practical elements of engineering—plans, specifications, equipment, people—during the construction and early operation of Brooklyn Edison's Hudson Ave Station, then the world's biggest. He was busy getting topnotch technical experience, but somehow it wasn't quite enough.

Looking for the missing element, Lou gave rein to a long-standing interest in management—sweated out a degree in business administration nights at NYU. And putting experience as editor of a college paper to work, he took on the job of getting out a publication for student members of ASME. Here, the first major piece of the pattern fell into place.

Phil Swain was seeking a young engineer for POWER's staff. What more natural than that he should mention it to his long-time friend George Stetson, Editor of *Mechanical Engineering*, and that George should recommend the young man who'd worked on *Student Branch News?* So, in 1937, Rowley came to POWER as Assistant Editor.

Now the pieces fell into place fast. Here was a chance to harness engineering savvy to journalistic imagination. And here was another opportunity Lou had been seeking —to make his skill and enthusiasm immediately and directly felt in a small, creative group.

The full pattern was revealed in 1945 when Rowley shouldered the administrative responsibilities as Managing Editor. At heart a perfectionist, he spearheaded an unremitting drive for the last ounce of editorial quality, for ever-greater engineering service in ever-more-original journalistic forms.

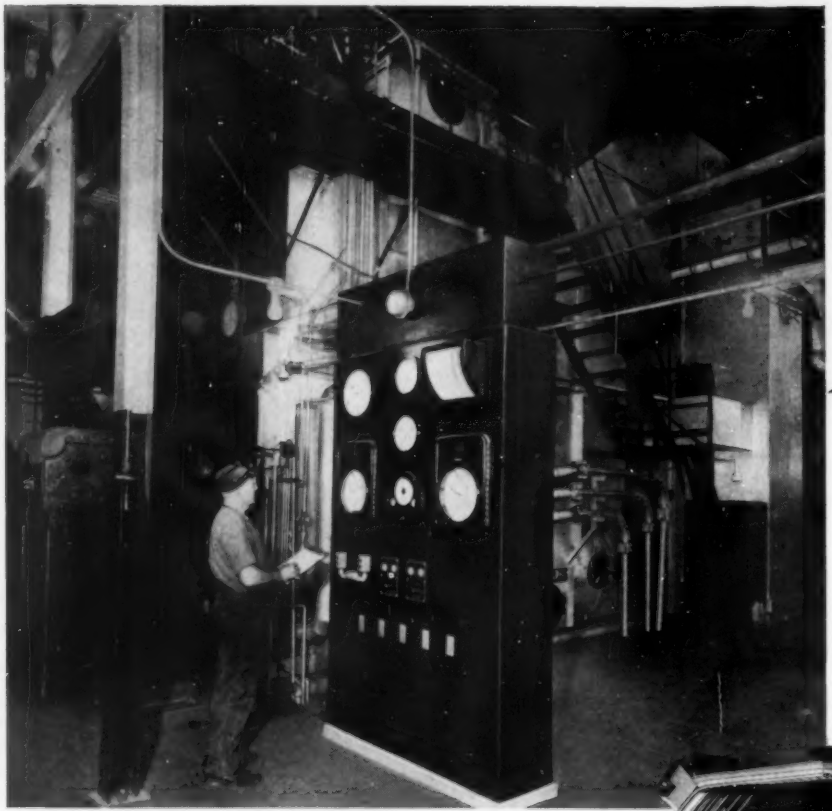
As POWER's "Exec," Lou runs what a British seaman would call a "taut ship"—but a happy one. Hardest worker on a hard-working staff, he can stop full in the midst of a big job—a major special section, say—relax completely, put his feet up and tell the newest LNR story.

With the same tact and human skill, Rowley has led engineers in many outside activities, notably in the American Society of Mechanical Engineers, where he has headed the Oil and Gas Power Division and other important activities. He's a member of Tau Beta Pi and a registered professional engineer.

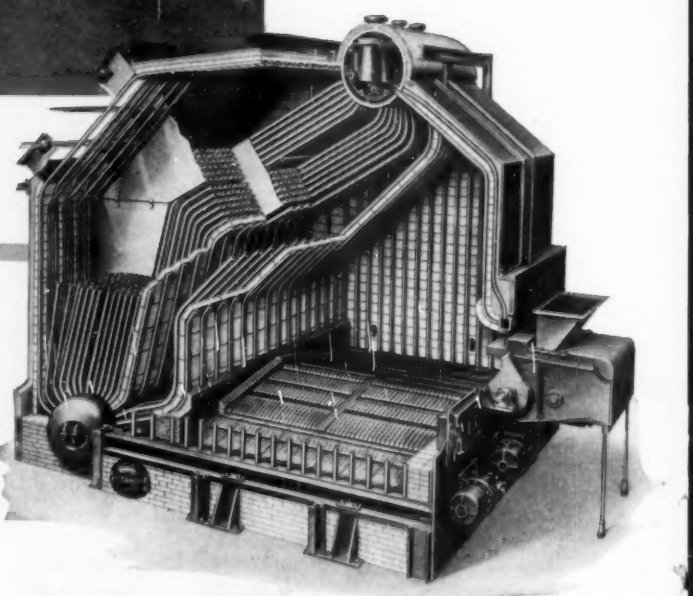
At his hilltop home in Port Washington, Long Island, Lou holds to the same blend of hard work and complete relaxation. Come Saturday, you're likely to find him laying up a stone wall or sawing fireplace logs. That evening he'll probably be reading Civil War history (or the latest whodunit), listening to favorite records on his recently rebuilt hi-fi rig, or to his wife and three boys in an impromptu jam session. And in the basement there's a spreading model railway system, with "Pop" as construction superintendent and the boys as operating crew.

Lou Rowley's travels have made him power-field friends from coast to coast. For those of you who haven't met him, this brief sketch will serve to introduce the man you will surely come to know better as the Editor of POWER.

VERIFIED FUEL SAVINGS



Boiler operator checks readings on control panel of company's new stoker-fired B&W Integral-Furnace Boiler, Type FF, which has performed so satisfactorily that fuel savings of more than 40 per cent have been estimated.



View of typical stoker-fired B&W Integral-Furnace Boiler, Type FF, similar to unit in service at Food Machinery & Chemical Corporation's Middleport, N. Y. plant. Suitable for stoker, gas, and oil firing, this B&W Unit is available in a steam capacity range of 8000 to 50,000 lb per hr at pressures to 600 psi. Complete design and operating details are described and illustrated in Bulletin G-71. Write The Babcock & Wilcox Company, Boiler Division, 161 East 42nd Street, New York 17, N. Y.

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"Good job—well done", is the comment of the Niagara Chemical Division of Food Machinery & Chemical Corporation, regarding the installation and continuing superior performance of a B&W stoker-fired boiler and air heater at this plant. Data on a weighed-coal metered-water test, run continuously for three days, showed that 128,180 lb of 13,105 Btu coal were required to produce 1,464,400 lb of steam. The operating conditions were—100 psi boiler pressure—feedwater at 225 F. The overall efficiency of this B&W Unit was calculated at 86.6% against a guaranteed 84% at 20,000 lb of steam per hr.

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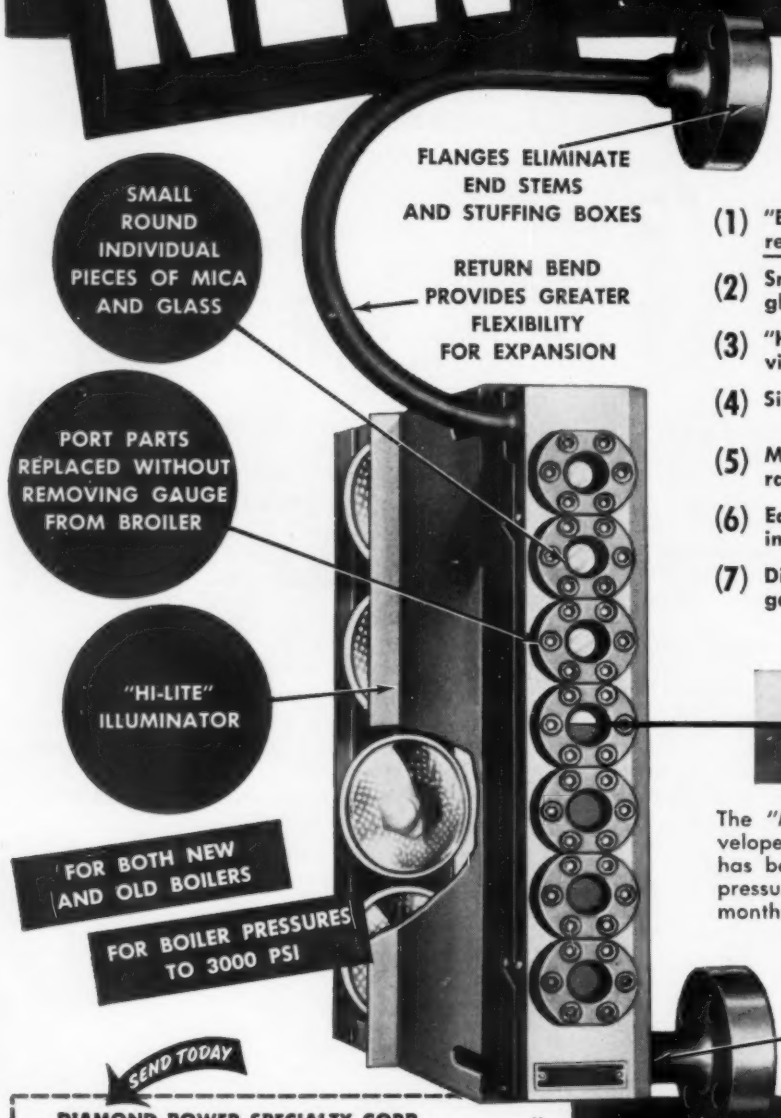

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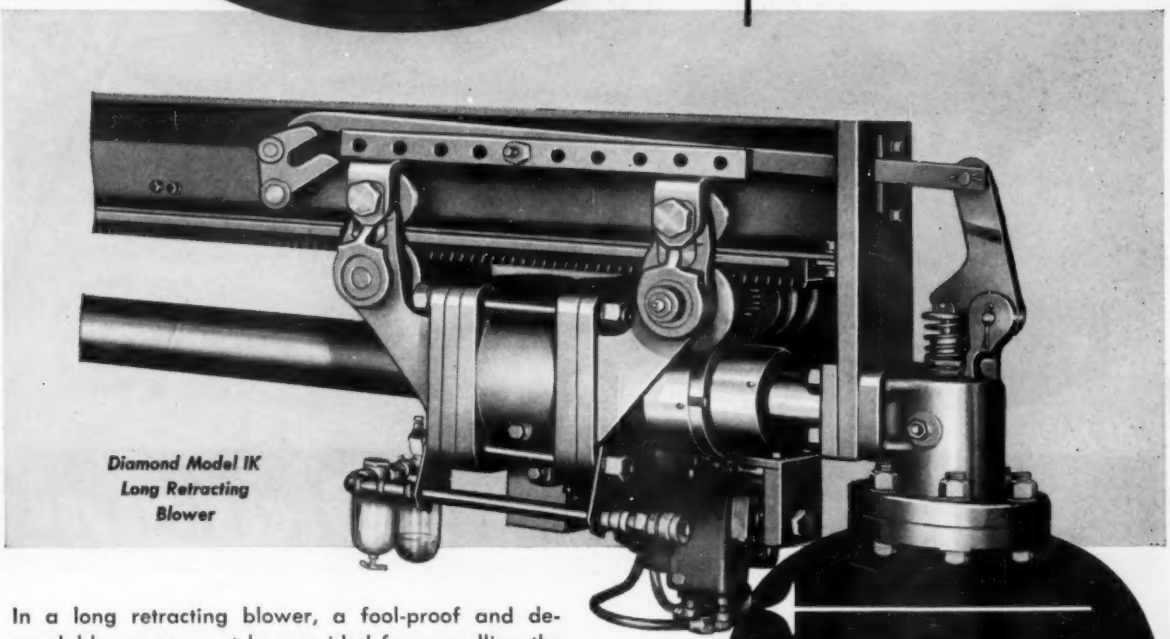

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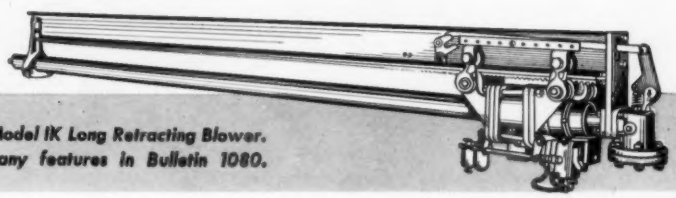
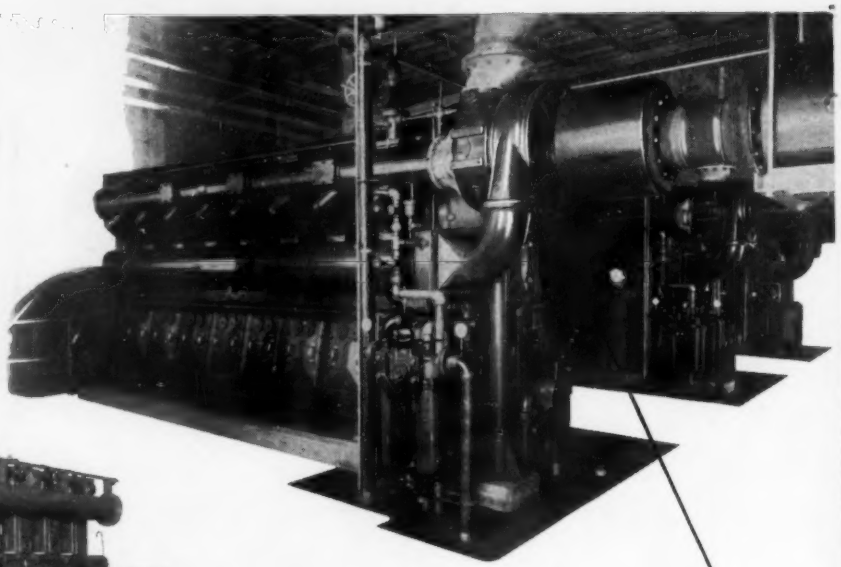
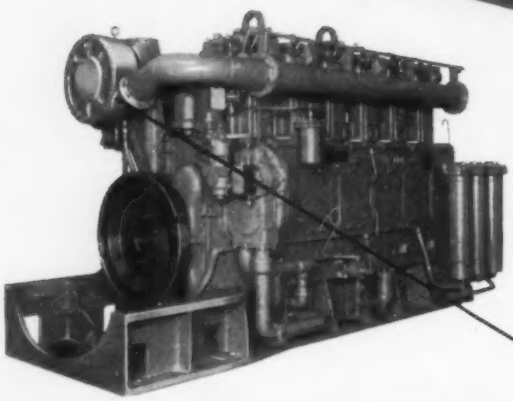


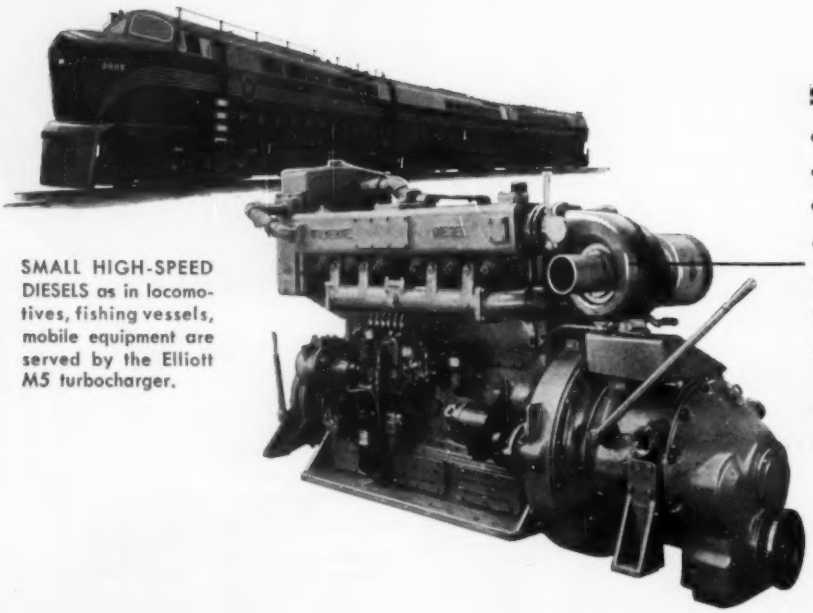
Diamond Model IK Long Retracting Blower. See its many features in Bulletin 1080.





MANY COMMUNITY POWER PLANTS AND INDUSTRIAL POWER PLANTS get the ultimate in diesel performance with Elliott turbochargers.

In diesel supercharging,

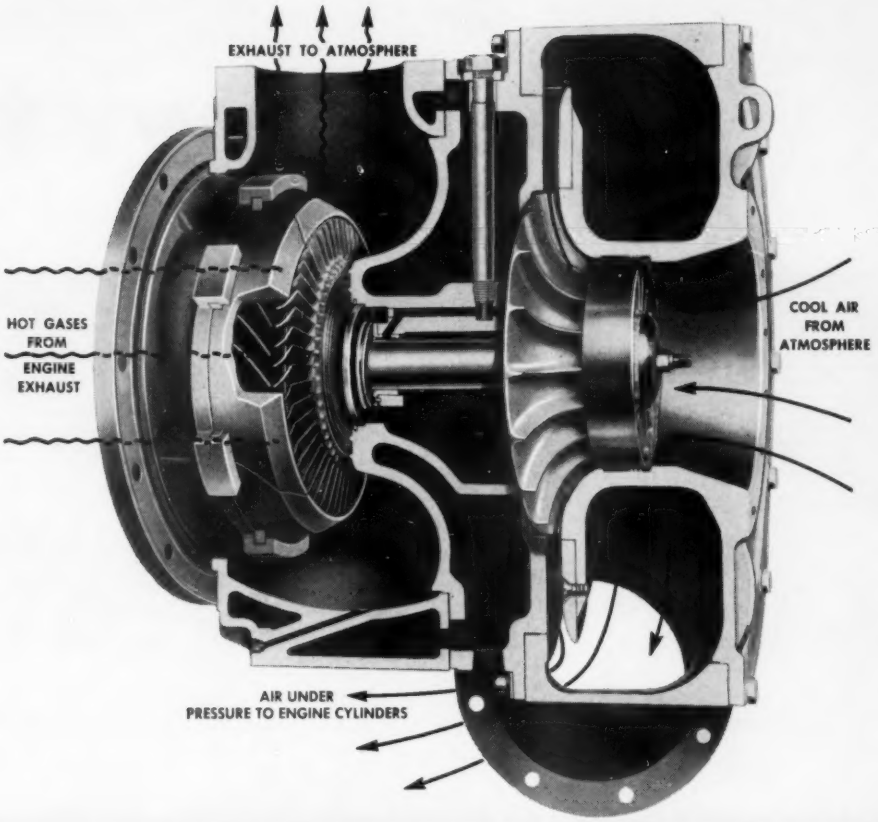


SMALL HIGH-SPEED DIESELS as in locomotives, fishing vessels, mobile equipment are served by the Elliott M5 turbocharger.

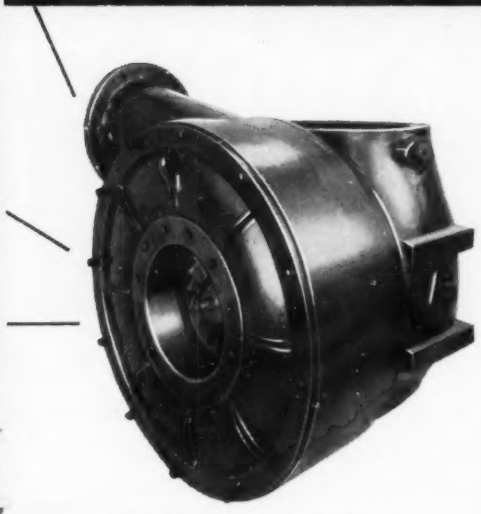
SOME ADVANTAGES

- Improved efficiencies
- Higher pressure ratios
- More air flow
- Lower weight/horsepower ratios
- Lower specific fuel rates
- Less lube oil consumption
- Greater capacity to handle overloads
- Better scavenging
- Improved thermal efficiencies

M4-6



play safe with ELLIOTT



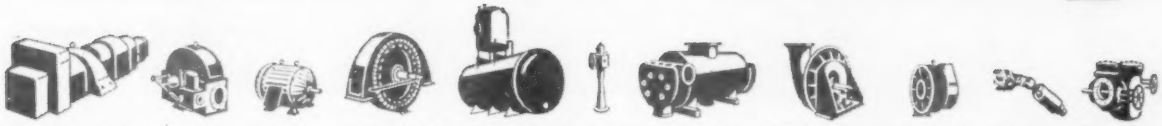
Elliott high-pressure turbocharger from air compressor end.

ELLIOTT TURBOCHARGERS in their design have long passed the stage of experimentation, and reached that of stabilized solutions in the many critical problems involved. This is the result of 14 years of Elliott experience in building and installing turbochargers on four-cycle diesels and more recently, on two-cycle engines as well. During this time over 10,000,000 hp of diesel engines has been turbocharged by Elliott.

Operated by the otherwise wasted energy of engine exhaust gases, Elliott turbochargers supply every function and advantage of supercharging without taking toll of engine power. Their application is an important economy in every way, and their performance is assured by the authoritative engineering experience back of them.

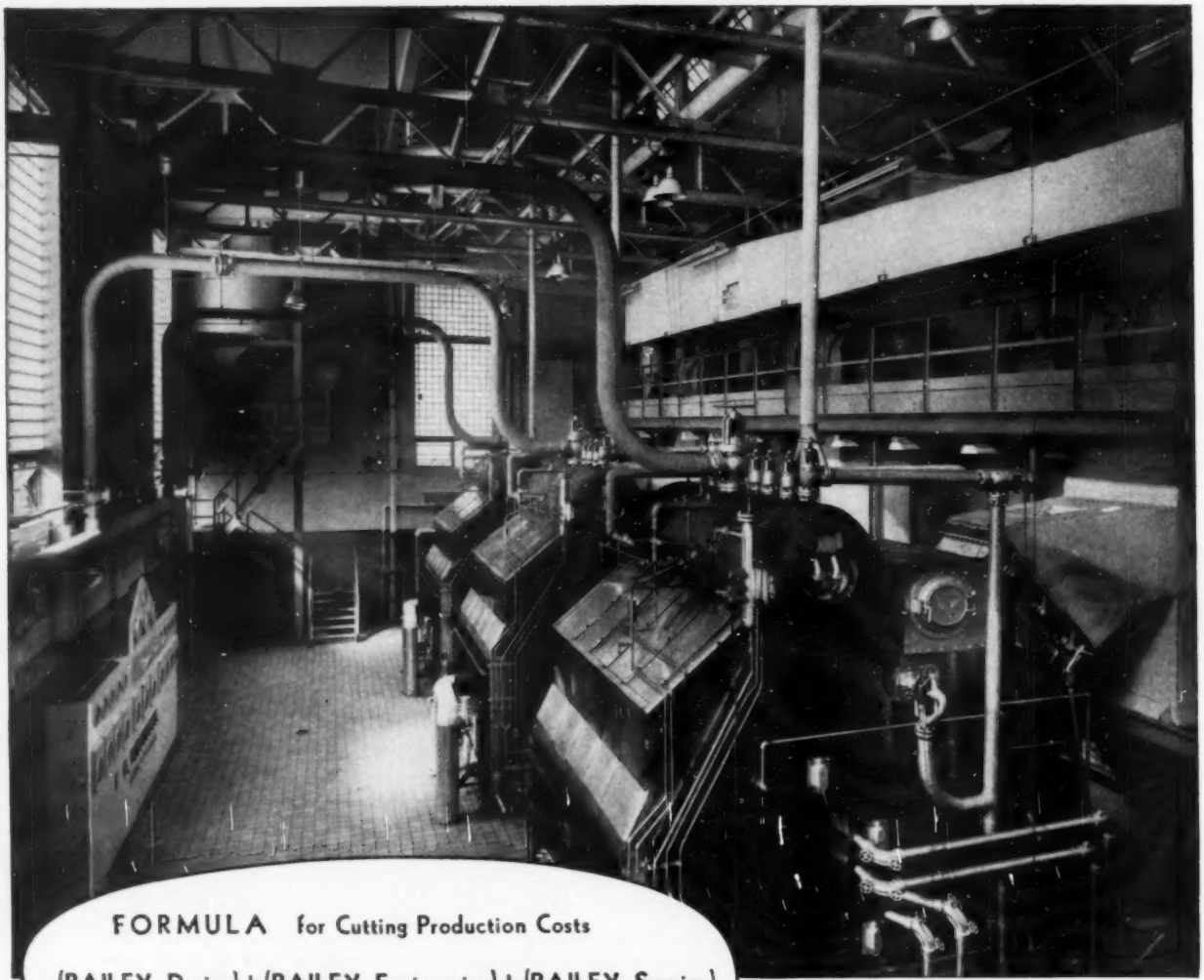
For complete data contact your local Elliott field engineer, or write Elliott Company, Supercharger Dept., Jeannette, Pa.

ELLIOTT Company



TURBINE-GENERATORS TURBINES MOTORS GENERATORS DEAERATING HEATERS EJECTORS CONDENSERS COMPRESSORS TURBOCHARGERS TUBE CLEANERS STRAINERS

How to



FORMULA for Cutting Production Costs

(BAILEY Design) + (BAILEY Engineering) + (BAILEY Service)

= GREATER SAVINGS PER FUEL DOLLAR

In the Nela Park central heating plant of General Electric Company, Bailey Meter Control insures efficient use of fuel. It enables operators to run these 18,000 lb per hour 125 psi spreader stoker-fired boilers under optimum conditions at all times.

Save Fuel

★ The productive energy produced by a unit of fuel depends on the way you put it to work in your boiler. How much heat energy you actually get depends upon the performance of your steam plant equipment.

That's where Bailey Controls can help. With a Bailey-engineered control system, you can count on a higher output of available energy per unit of fuel. Here's why:

1. Complete Range of Equipment—fully co-ordinated

You need never worry that a Bailey Engineer's recommendation is slanted in favor of a particular type of equipment, as might be the case if he had only a limited line to sell—or that Bailey will pass the buck for efficient control; we offer *complete* boiler control *systems*.

2. Engineering Service—backed by experience

No other manufacturer of instruments and controls can offer as broad an experience based on succesful installations involving all types of combustion, flow measurement, and automatic control.

3. Direct Sales-Service—conveniently located near you

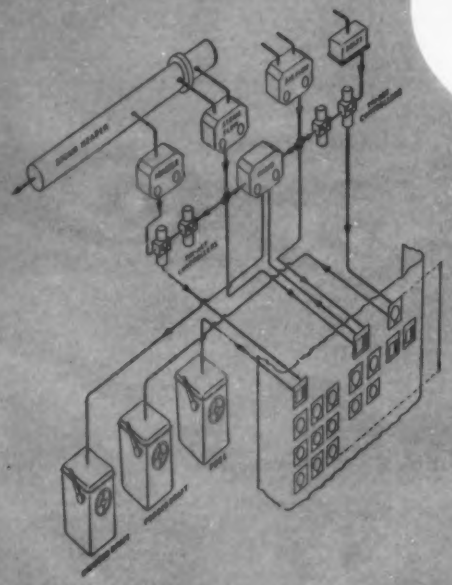
Bailey Meter Company's sales-service engineers are located in more industrial centers than those of any other manufacturer of boiler control systems; you get prompt, experienced service with a minimum travel-time and expense.

For greater fuel savings, less outage, and safer working conditions you owe it to yourself to investigate Bailey Controls. Ask a Bailey Engineer to arrange a visit to a nearby Bailey installation. We're proud to stand on our record.

A-117-2

BAILEY
METER COMPANY
1036 IVANHOE ROAD
CLEVELAND 10, OHIO
Complete Controls for Steam Plants

BAILEY METERS
Controls for
COMBUSTION
FEED WATER
TEMPERATURE
PRESSURE
LIQUID LEVEL
FEED PUMPS



COPES VULCAN offers

COMBUSTION CONTROL

You can save fuel, labor and maintenance dollars by installing modern Copes-Vulcan combustion control.

You can be sure of:

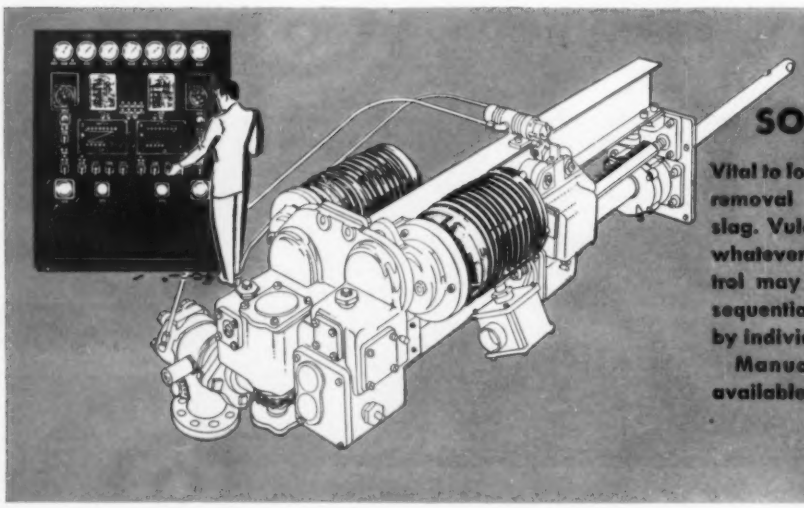
—highest combustion efficiency
—constant furnace pressure
—constant steam pressure and temperature

***Bulletin 1007-A* describes this new approach to boiler control through**

C·V+T=BBC

COPES·VULCAN+*Taylor*=BETTER BOILER CONTROL

Reduce your steam costs. Get more efficient and safer boiler operation. Use one or more of these four Copes-Vulcan aids to offset rising costs of fuel, labor and maintenance. C • V + T offers a new approach to boiler control—with undivided responsibility from analysis to installation—and service wherever needed for the life of the installation.



SOOT BLOWING

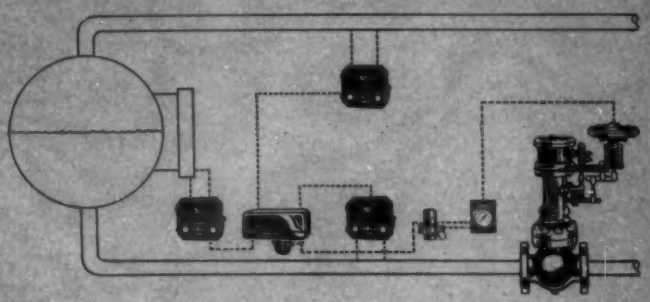
Vital to lower steam costs is the regular removal of soot, sintered dust and slag. Vulcan does this job effectively, whatever the size of your boiler. Control may be automatic or automatic-sequential—through central panel or by individual push buttons.

Manually-operated blowers are available. *Write for Bulletin 1001.*

4 aids to lower steam costs

FEED WATER CONTROL

Copes feeds exactly as needed to maintain correct water level while meeting steam demands. Three-, two- or one-influence systems are available for your specific needs. Control may be independent, or tied in with combustion control. Take a look at the newest three-influence COPES instrument-type feed water control system—Type 3-I, described in *Bulletin 1013.*



COPES VULCAN

COPES-VULCAN DIVISION

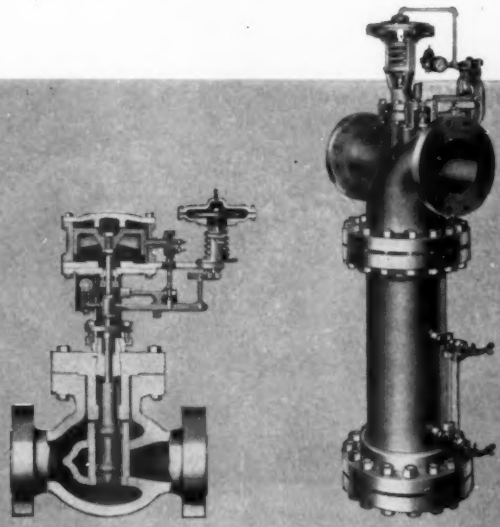
CONTINENTAL FOUNDRY & MACHINE COMPANY

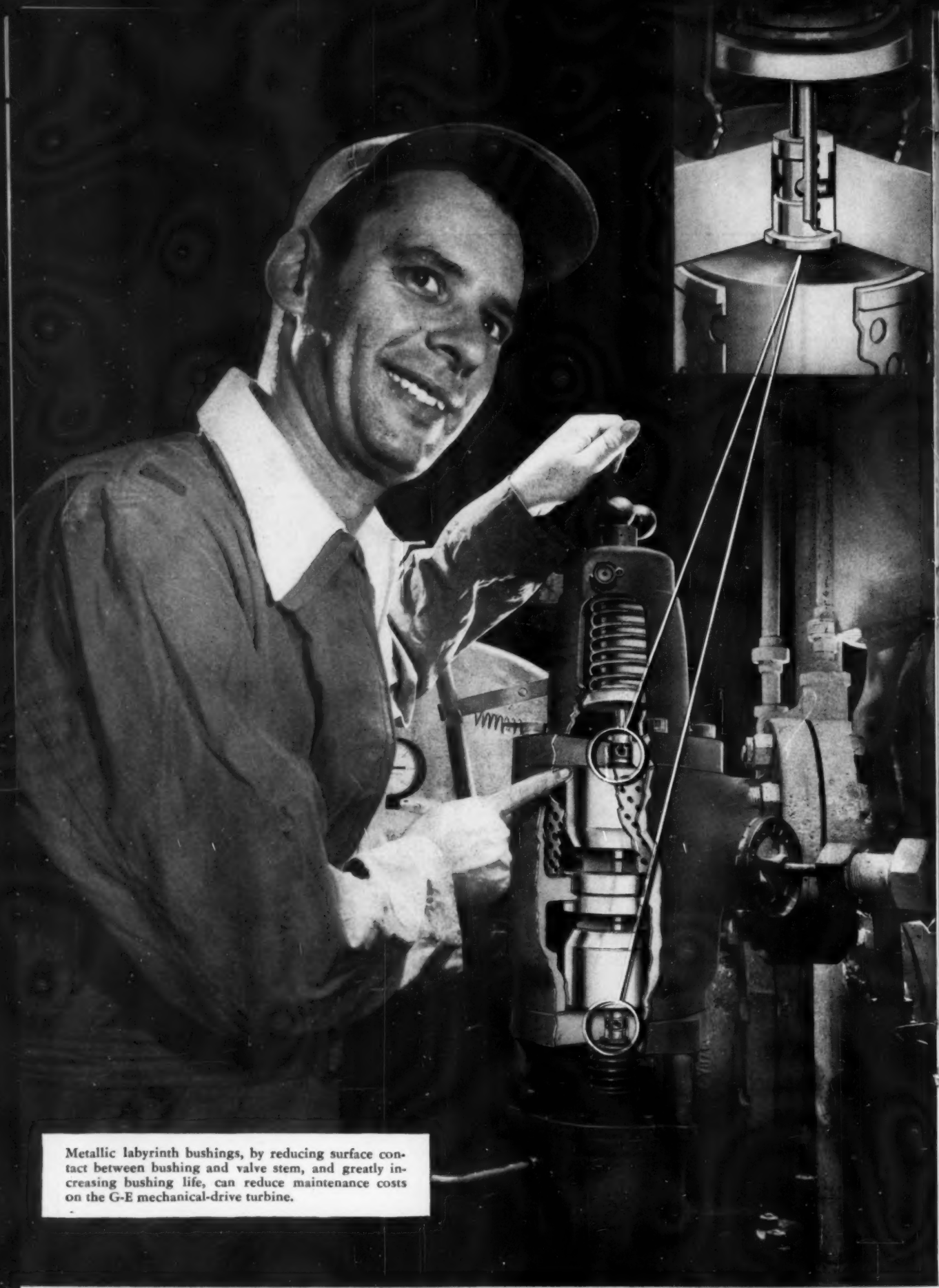
ERIE 4, PENNSYLVANIA

REDUCING and DESUPERHEATING

Copes Reducing Valves have ports characterized for specified flow and pressure conditions. Rugged construction throughout. *Write for Bulletin 477-A.*

Copes Desuperheaters are self-contained, need no "extras" for installation. Temperature control is accurate, even on lightest flows, because cooling water is fully controlled inside the chamber. *Bulletin 405-C.*





Metallic labyrinth bushings, by reducing surface contact between bushing and valve stem, and greatly increasing bushing life, can reduce maintenance costs on the G-E mechanical-drive turbine.

ANOTHER PLUS VALUE OF G-E MECHANICAL-DRIVE TURBINES...

Metallic Labyrinth Bushings Cut Turbine Maintenance Costs

Using metallic labyrinth bushings instead of soft packing on the throttle valve stem and operating valve stem of General Electric's Type DP mechanical-drive turbine has several important advantages. Corrosive attacks on the valve stems, often caused by soft packings, are prevented.

Because surface contact between bushing and valve stem is reduced to a minimum, friction is practically eliminated—bushing life is increased tremendously. This feature alone can save you up to $50.00 in direct maintenance costs—plus the expense of down-time caused by frequent packing replacements.

HERE'S ANOTHER ADVANTAGE. Since frictional drag on the governing system is reduced to a minimum, you get more accurate, sensitive, reliable governing with G.E.'s Type DP turbine.

Metallic labyrinth bushings make an effective steam seal by means of grooves in the bushing which throttle pressure and minimize any steam leakage (see illustration).

THESE METALLIC LABYRINTH BUSHINGS are just one of many DP features which save you money throughout total turbine life. The chart below indicates other areas of savings.

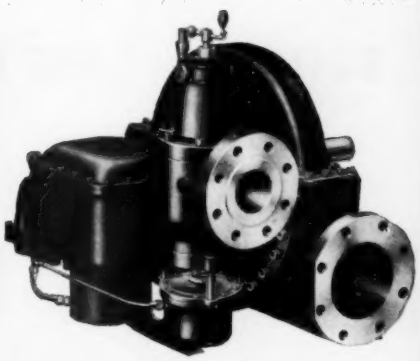
Remember—the total cost is often more than just the sales price. But G.E.'s standard DP turbines include the extra features that save you extra costs. For more information contact your nearest G-E apparatus sales office. Write for bulletin GEA-4955A, "A New Standard in Mechanical-drive Turbines." General Electric, Schenectady 5, N.Y.

252-66

GENERAL ELECTRIC

INSTALLATION AND MAINTENANCE COST-SAVING FEATURES

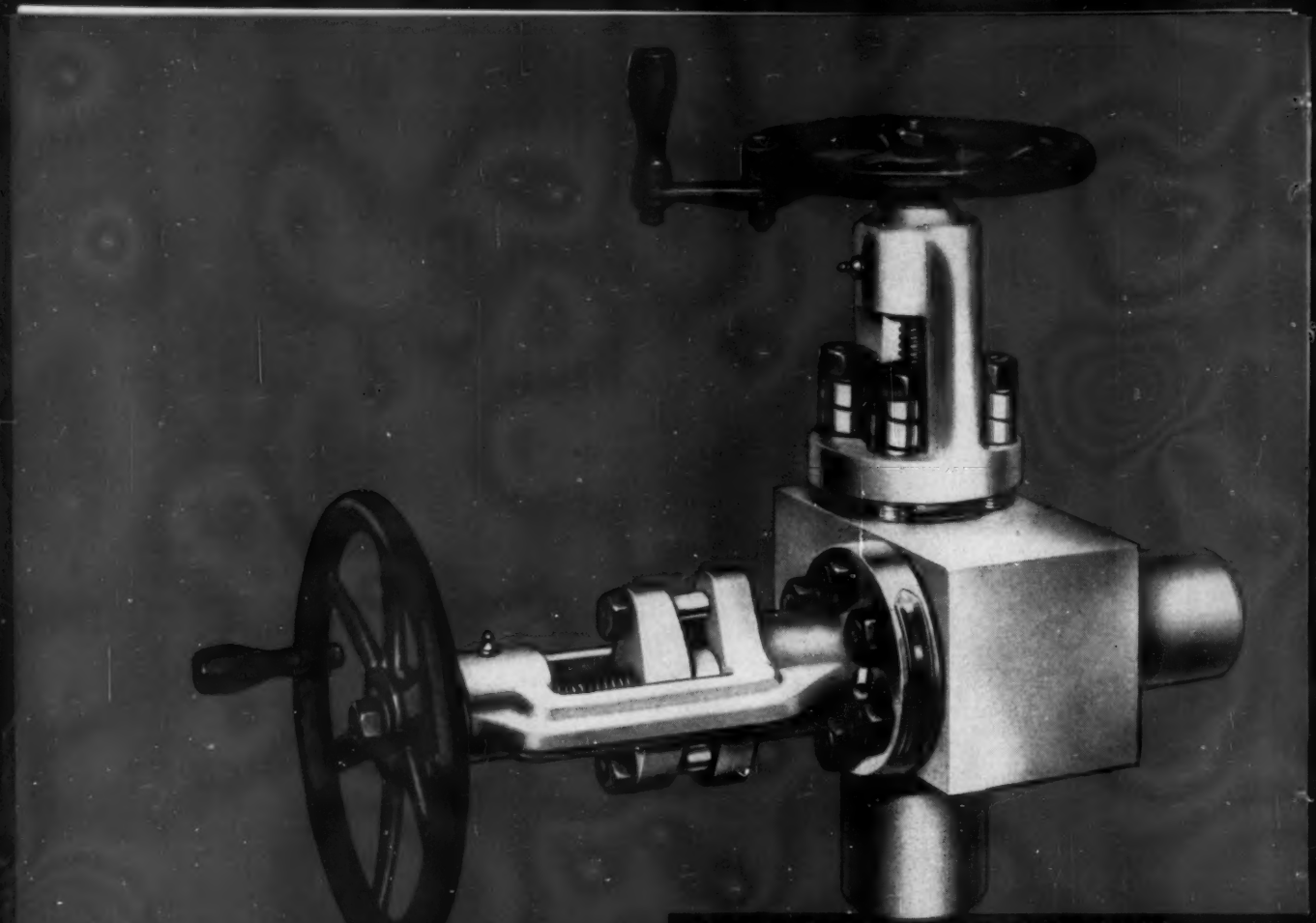
THESE EXTRA FEATURES, STANDARD ON ALL G-E TYPE DP TURBINES, CAN . . .	Save You up to
COMBINED TRIP-THROTTLE VALVE Eliminate extra cost of buying and installing valve ahead of the turbine.	$200.00
SINGLE RESERVOIR FOR COOLING LUBE OIL Eliminate extra cost of piping cooling water to and between bearings.	50.00
MAJORITY OF PARTS INTERCHANGEABLE One set of spare parts protects several units—less money tied up in inventory.	100.00
METALLIC-LABYRINTH VALVE STEM BUSHING Eliminate labor costs of replacing soft packings; cut down-time production losses.	50.00
SHAFT MONEL-SPRAYED AT PACKING FIT Saves frequent cost of purchasing and installing carbon rings; contributes to long shaft and packing life.	20.00
ESTIMATED TOTAL SAVINGS	$420.00



G-E Type DP Mechanical-drive Turbine

COMPARE THE FEATURES
EVALUATE ALL THE COSTS

See why G-E Standard Type DP turbines are your most economical buy.



YARWAY UNIT TANDEM BLOW-OFF VALVE . . .
with welding ends. Flanged ends also available.

BUILT TO "TAKE IT" AT

HIGH PRESSURES

● As boiler pressures go up . . . so does the demand for Yarway Unit Tandem Blow-Off Valves. *Why do more than 4 out of 5 high-pressure boiler plants now use Yarway Blow-Off Valves?*

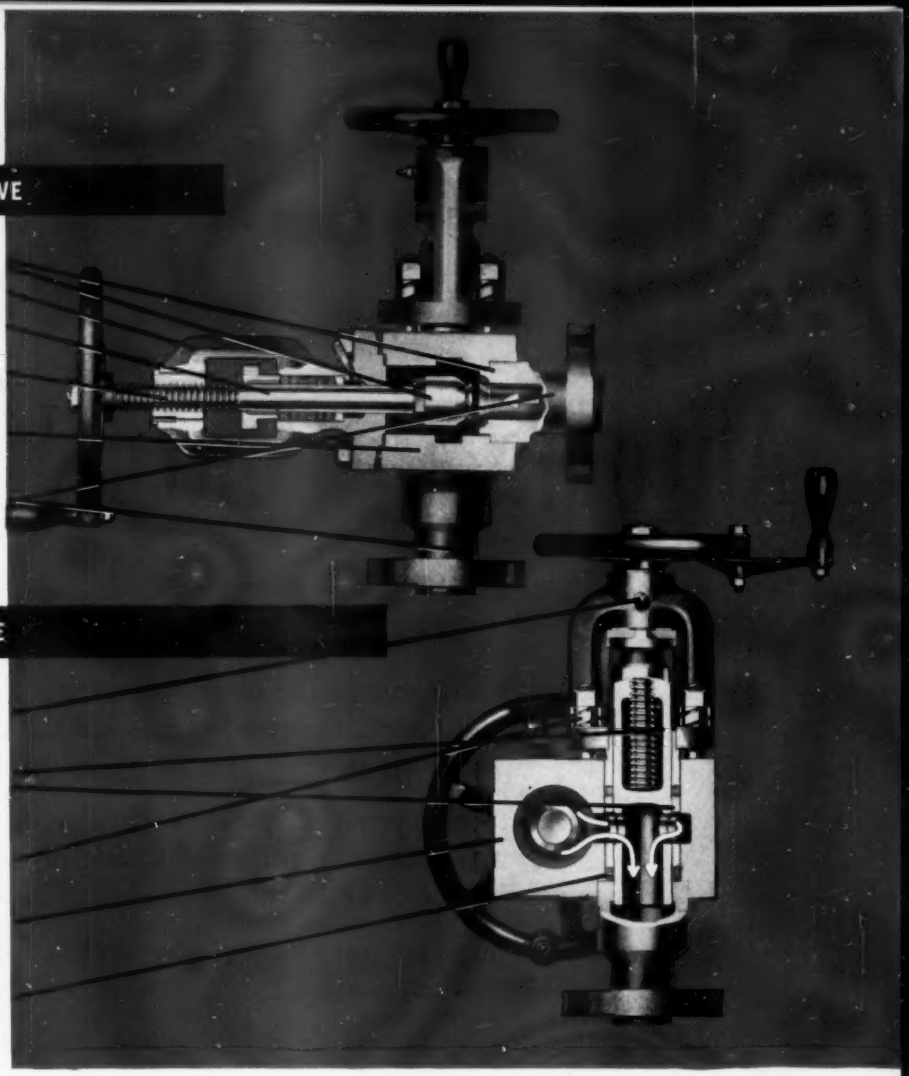
Yarway Unit Tandems are designed for strength, built to safeguard lives and investments, and to withstand severest acid-wash service.

A rugged, compact one-piece forged steel block serves as the space-saving common body for both valves, eliminating intermediate connections. Stelliting on seats and discs in the hard-seat valves provides longer life and better service. Balanced sliding plungers do the same on the seatless-type valves. Other design and metallurgy features add a high safety factor.

A FEW TYPICAL USERS

UTILITIES

Philadelphia Electric Company
Pacific Gas and Electric Company
Dallas Power and Light Company
Boston Edison Company
Cleveland Electric Illum. Co.



HARD-SEAT (Blowing) VALVE

Stellited and ground disc and seat.

Cast Steel Yoke.

Stainless steel stem.

Alemite lubrication (fitting on yoke hub) of stem and bushing threads.

One-piece forged body of carbon steel. Carbon-moly steel available on request.

Inlet and outlet nozzles welded into body. Flanged or welding ends provided.

SEATLESS (Sealing) VALVE

Alemite lubrication of plunger and ball thrust bearing in yoke.

Nitralloy plunger and lower follower gland. Stainless steel plunger and Ni-Resist gland available for acid wash service.

Yoke springs maintain required pressure on packing at all times.

One-piece forged body of carbon steel. Carbon-moly steel available on request.

Laminated lower packing ring with stainless steel reinforcing inserts.

Unit Tandems are available in the hard seat—seatless valve combination for pressures to 1500 psi, or in the hard seat—hard seat combination for pressures to 2500 psi. Both provide positive opening and closing with drop-tight shut-off.

Write for Yarway Bulletin B-434.

YARNALL-WARING COMPANY

100 Mermaid Avenue, Philadelphia 18, Penna.

BRANCH OFFICES IN PRINCIPAL CITIES

YARWAY® blow-off valves

INDUSTRIAL PLANTS

Toledo Edison Company
Georgia Power Company
Union Electric Co. of Missouri
Rochester Gas and Electric Co.
Indianapolis Power and Light Co.

Bethlehem Steel Company
Ford Motor Company
Weyerhaeuser Timber Co.
Anheuser Busch Company
Procter & Gamble Company

Southern Kraft Corporation
Chrysler Corporation
Container Corp. of America
Eastman Kodak Company
American Viscose Company

HAGAN

Automatic Control Systems

The many advances in the design of components and the arrangements of Hagan Automatic Control Systems are the result of thirty-five years of experience with all types of control problems.

The accuracy, dependability and versatility of each unit permit Hagan engineers to select the right combination of equipment for coordinated accomplishment of every function required of a system.

The following are just a few of the services for which successful applications have been made.

Automatic combustion control for boilers of any size or pressure, firing all types of fuels, singly or in multiple.

Boiler drum water level control, with automatic compensation available for boiler load or water density.

Draft or pressure control over a continuous range from fractions of an inch water column to 5000 psig.

Superheated steam temperature control.

Steam pressure and temperature control for all types of reducing and desuperheating stations.

Controls for air preheated temperatures.

Feedwater heater pressure or temperature controls.

Controls for parallel or sequential operation of fans, blowers or pumps.

HAGAN
HALL
BUROMIN
CALGON

HAGAN

Ring Balance Instruments

When you buy Hagan Ring Balance Instruments, you choose the most versatile units available for the service involved. The following are some of the factors which make this a reality:

Interchangeable sensing elements for full scale differentials from 1″ to 560″ WC.

Full scale range of each element adjustable over 7 to 1 ratio.

Dead weight calibration check can be made without disconnecting the meter from the line.

Spring resistance system produces reliability at lower flow ranges.

Mercury level is not critical.

No stuffing boxes or pressure-tight bearings.

Ample operating power at all rates of flow.

The breadth of application of Hagan Ring Balance Meters is indicated by these successful installation types.

Recording, indicating and integrating flows of water and steam, or liquid and gaseous fuels.

Simultaneous records of two separate flows, measured in a single meter housing. Flows may be added or subtracted for accounting and distribution purposes.

Pressure and temperature compensated records of steam and gas flows.

Pneumatic or electric signal transmission available.

Density compensated recording of boiler drum water level.

Density compensated recording of gas or liquid flows.

Flow ratio control for liquids and gases.

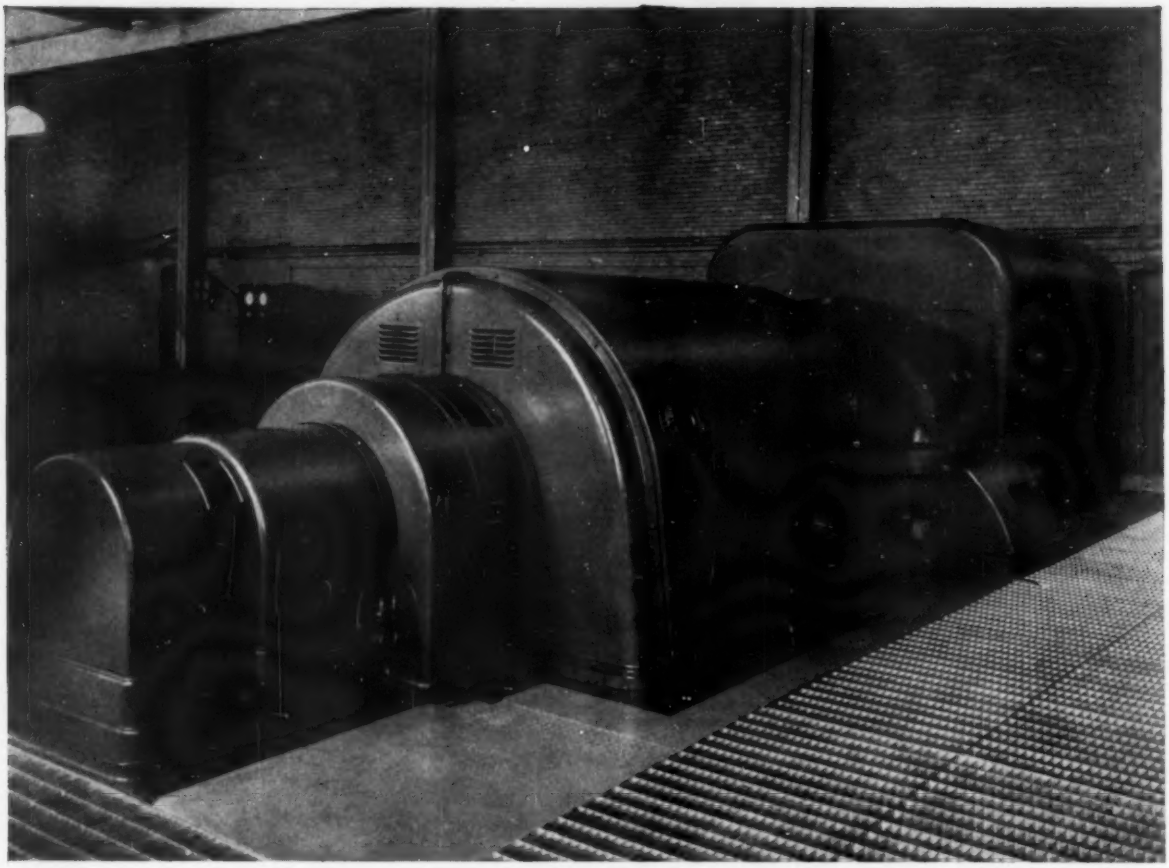
Remote recording, indicating and integrating.

Our engineers will be glad to suggest the Automatic Control and Instrumentation best suited to your requirements.

HAGAN CORPORATION

HAGAN BUILDING PITTSBURGH 30, PENNSYLVANIA

Boiler Combustion Control Systems • Ring Balance Flow and Pressure Instruments • Metallurgical Furnace Control Systems • Control Systems for Automotive and Aeronautical Testing Facilities



SECOND WORTHINGTON TURBINE GENERATOR installed at the Kohler Co. in Kohler, Wisconsin. Steam is extracted from this 6000-kw unit at the rate of 120,000 lb/hr. at 225 psi and 80,000 lb/hr. at 5 psi.

KOHLER OF KOHLER selects Worthington again

In 1949, Kohler of Kohler, manufacturers of plumbing fixtures, heating equipment, electric plants, air cooled engines and precision controls, installed their first Worthington turbine generator.

The 3000-kw Worthington unit operated in parallel with the outside power supply and delivered the rated kw load while automatically extracting 120,000 lbs. of steam per hour at 225 psi for heating and process work.

Because of the extremely economical and dependable operation of this machine, another Worthington turbine generator was the logical choice when power requirements increased. In November of 1952, a 6000-kw Worthington turbine generator was installed.

Now the two Worthington units furnish process steam for the plant and also supply a large part of their electrical requirements.

Follow the lead of Kohler and find out how Worthington turbine generators can pay off for you, too. Write to Worthington Corporation, Steam Turbine Division, Section T.4.5, Wellsville, New York.

T.4.5

WORTHINGTON

STEAM TURBINES

Single- and Multi-Stage Turbines • Turbine-Generators • Deaerators • Boiler Feed Pumps • Surface Condensers

A GREAT TEAM IN STEAM

Photo courtesy of Fort Worth Star-Telegram.

Don't let emergencies shut down your production

WORTHINGTON'S SELF-POWERED, SELF-PRIMING PORTABLE PUMP is ideally suited for emergency service in industrial floods, or for pumping from sumps or excavations. Size 20-I is shown.

A fast-acting Worthington emergency pump might have kept this plant operating

You can't always prevent an industrial flood, but you can often control it with a Worthington self-priming, self-powered portable pump. What's more, you'll probably be able to get the flood water cleaned up in time to keep production on schedule, too.

Especially designed for emergency service, these centrifugal pumps are self-powered for use in the event of electrical failure. They're portable and self-priming, too, so they can go into action immediately when needed. And they have suction lifts up to 25 feet at sea level for removing floor water trapped in sumps, pits, ditches, trenches or other excavations.

The Worthington self-priming portable pump line includes seven units with ratings of 4,000 to 42,000 gallons per hour. Write for complete information to Worthington Corporation, Centrifugal Pump Division, Section C.3.3, Harrison, New Jersey.

C.4.1

WORTHINGTON

THE WORLD'S BROADEST LINE ASSURES YOU THE RIGHT PUMP FOR EVERY JOB

CENTRIFUGAL • ROTARY • STEAM • POWER • VERTICAL TURBINE

Boiler-Burner Team Wins Seven Straight

Phillips Chemical Company orders Vogt boiler and Coppus-Dennis FANMIX burner combinations to make 1¾ million pounds of steam an hour

When a customer praises a product, that's fine. But when a customer *continually re-orders*, that's conclusive proof of user-satisfaction.

Phillips Chemical Company, Borger, Texas — producer of synthetic rubber — first installed Henry Vogt boilers with FANMIX burners back in 1943. As plant production increased, Phillips again purchased the same equipment — in 1946, and again in 1951.

Today, a total of 7 Vogt boilers equipped with Coppus-Dennis FANMIX burners provide 1,750,000 lbs. steam each hour for the production of synthetic rubber. The boilers are designed for 250,000 lbs. steam peak operation but have been operated as high as 275,000 lbs. per hour. Their performance is typical of the efficiency of boilers equipped with Coppus-Dennis FANMIX burners.

FANMIX • Better Combustion • Better Efficiency • Higher Ratings

All Coppus-Dennis FANMIX burners — for gas as well as combination gas-oil — have the exclusive FANMIX action. Their *revolving orifices* give violent mechanical mixing and agitation of gas and air, therefore causing instantaneous and complete combustion with *minimum excess air* (5% excess air is not unusual).

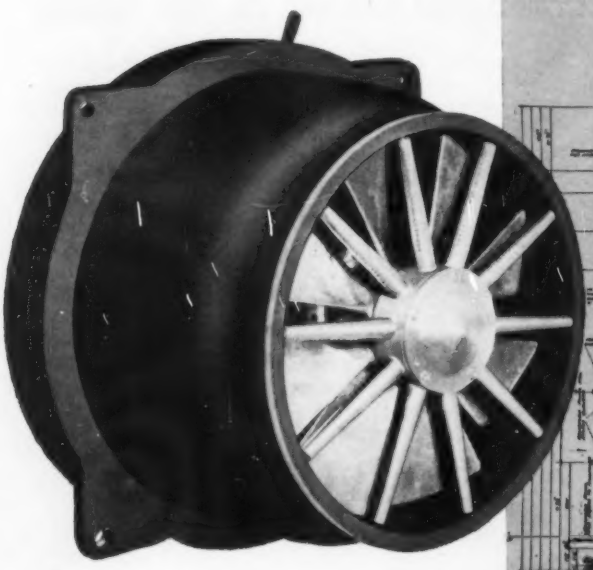
Because of this exclusive FANMIX action, furnace space is not required for mixing and *higher boiler ratings* are thus easily obtained. The burners also have a shorter flame than any other burner and will not cause flame impingement.

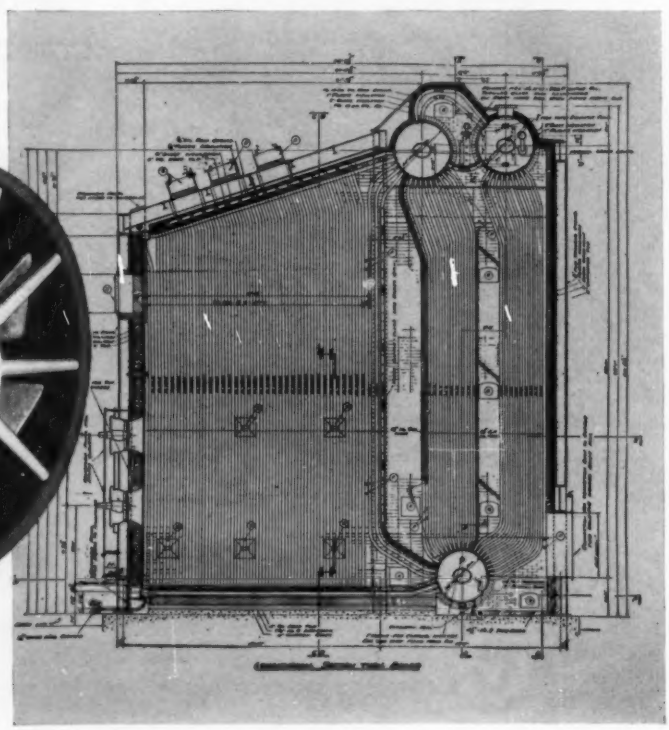
What's more, by incorporating a *fan* as an integral unit, FANMIX burners have *no draft loss* across the burner. As a result, increased ratings are possible regardless of draft conditions.

FANMIX action, with its quick completion of combustion, gives *lower* exit temperatures.

If you are not using Coppus-Dennis FANMIX burners in your present boiler, why not plan now to take advantage of the exclusive FANMIX action? You need no forced draft equipment, increase in stack or increase in furnace volume for FANMIX operation. And you get increased capacity. When specifying FANMIX on *new* boilers, you can plan on reduced combustion space, higher ratings, less stack height or reduced induced draft capacity — and, of course, *no* forced draft equipment.

For further information, mail coupon today. Sales offices in *Thomas' Register*. Other "Blue Ribbon" Products in *Chemical Engineering Catalog, Refinery Catalog, Best's Safety Directory* and *Mining Catalogs*.





JET REACTION is utilized to rotate fan which is integral part of burner. Ideal mixture for fast, complete combustion and peak efficiency is caused by automatically proportioned high velocity air passing at right angles through fuel.

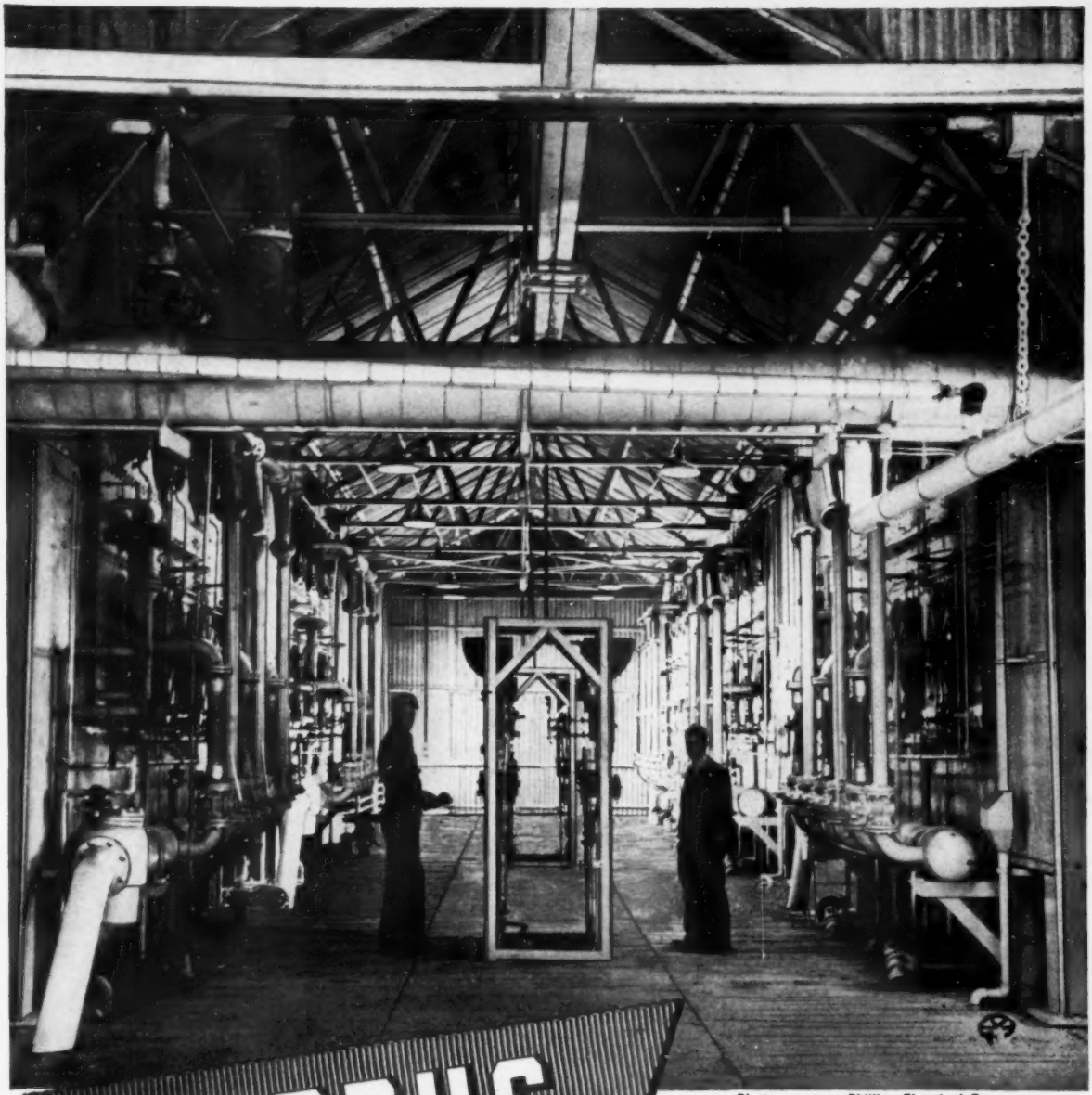


Photo courtesy Phillips Chemical Co.

HENRY VOGT BOILERS are here shown installed in the Phillips Chemical Company, Borger, Texas. Boilers use Coppus-Dennis FANMIX burners.

SEND COUPON for further information. Coppus engineers FANMIX burners to your individual requirements.

PLEASE ATTACH THIS COUPON TO YOUR COMPANY LETTERHEAD

COPPUS ENGINEERING CORPORATION
169 Park Avenue
Worcester 2, Massachusetts

Please send complete data on Coppus-Dennis FANMIX Burners. I'm particularly interested in ☐ gas ☐ combination gas-oil.

Name.....Title.....

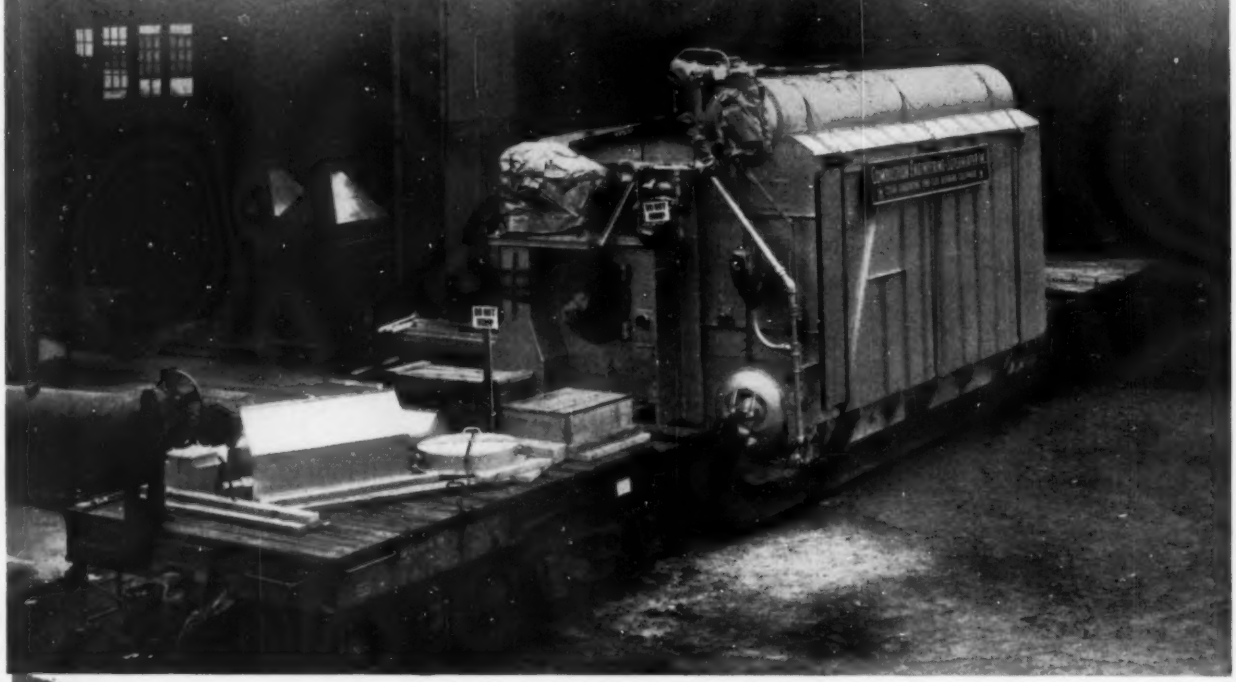
Company.....

Address.....

City.....Zone.....State.....

NOW YOU CAN GET THE VP BOILER

UP TO 40,000 POUNDS PER HOUR CAPACITY



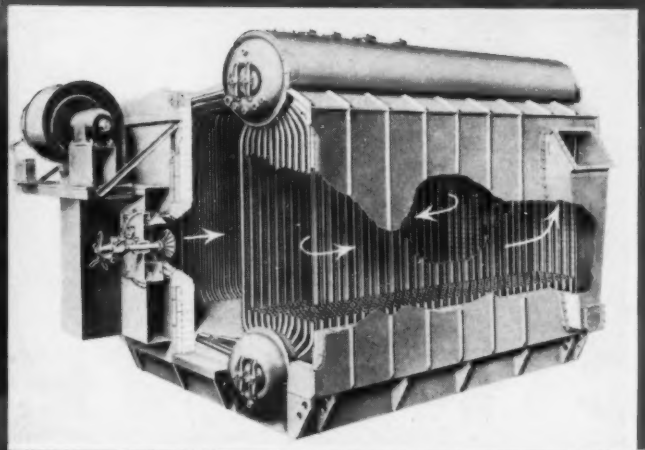
Now the many advantages of the C-E Package Boiler, Type VP, are available to you in an even higher range of capacities. For Combustion has added two new sizes – for capacities of 35,000 and 40,000 pounds of steam per hour.

No C-E boiler has ever "caught on" more quickly or received more widespread and enthusiastic acceptance than the VP. This can only reflect the *plus* values of its Extra Features such as:

- **More water cooling per unit of furnace volume than any other boiler of the VP's size and type.**
- **Quiet centrifugal fan, which operates at low speed and with an exceptionally low noise level.**
- **Large lower drum, which facilitates handling wide load swings . . . permits a simple, symmetrical tube arrangement . . . simplifies inspection.**
- **Single Burner—balanced furnace conditions are easier to get and to maintain . . . no duplication of burner control equipment . . . no air leakage through idle burner . . . change oil gun, when required, in seconds.**
- **Simple baffle arrangement, which means maximum heat transfer rate . . . no dead gas pockets . . . simplified soot blowing.**

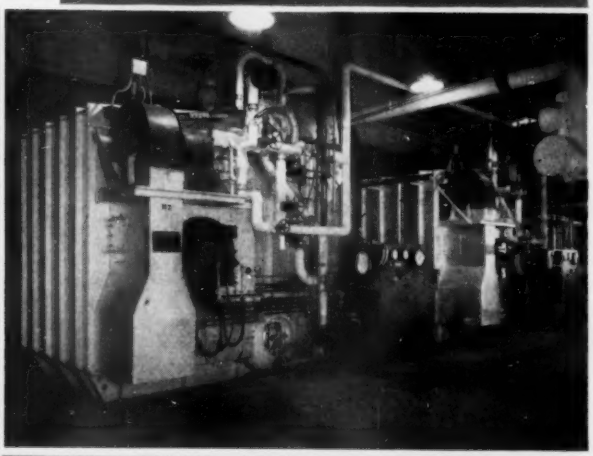
Consider, too, that many companies are discovering that they can get increased flexibility—at lower cost – by meeting their entire steam requirements with two or more VP boilers rather than with a single, larger unit.

Why not investigate the extra values you can have with Combustion's VP Boiler. Send for your copy of Catalog VP-105 or, even better, have a C-E engineer discuss your needs with you or your consultants. No obligation, of course. B-774



SPECIFICATIONS
of the VP Boiler

Capacity—4,000 to 40,000 pounds of steam per hour
Pressures—up to 500 pounds per square inch
Fuel—oil or gas
Erection — completely shop-assembled
Foundation—simple concrete slab



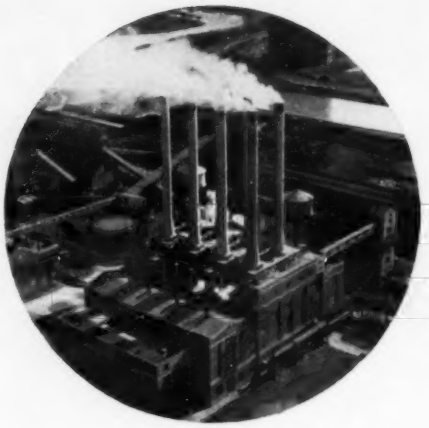
C-E

COMBUSTION ENGINEERING

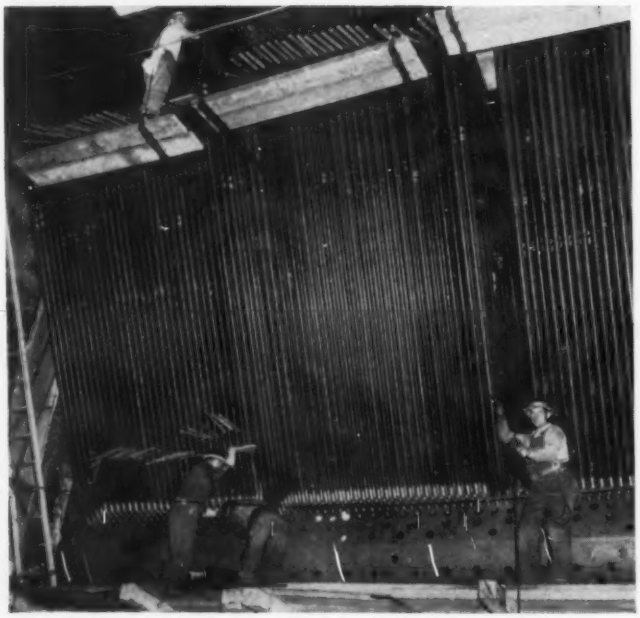
Combustion Engineering Building
200 Madison Avenue, New York 16, N. Y.

BOILERS, FUEL BURNING & RELATED EQUIPMENT; PULVERIZERS, AIR SEPARATORS & FLASH DRYING SYSTEMS; PRESSURE VESSELS; AUTOMATIC WATER HEATERS; SOIL PIPE

Latest additions to Ford Motor Company's power plant are two drum bent tube twin boilers. Each has 3,948 tubes. Evaporation, 500,000 lbs. steam per hour. Temperature at Superheater outlet 650°F. Pressure at Superheater outlet 250 p.s.i.g.



Ford uses ELECTRUNITE boiler tubes in

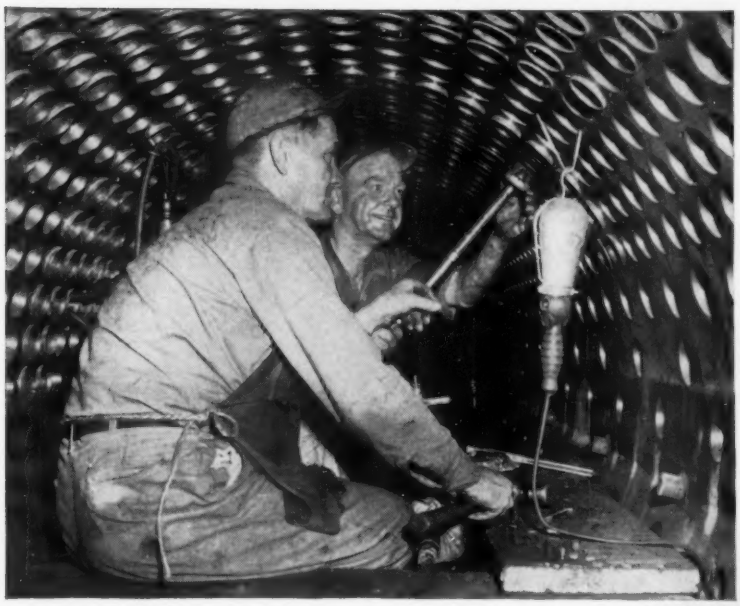


This latest boiler installation is part of Ford's continuing modernization program. At the Rouge, which has the largest industrial power plant in the world, Combustion Engineering Inc., is furnishing specially designed boilers.

The ELECTRUNITE Boiler Tubes used are made from high grade steel, made in Republic's own mills. Quality is controlled from ore to finished product through a series of rigid tests and inspections.

The results: Tubes with uniform wall thickness which give uniform heat transfer all around the tube and from end to end. Uniform ductility for smooth bending and uniform roller-expanding.

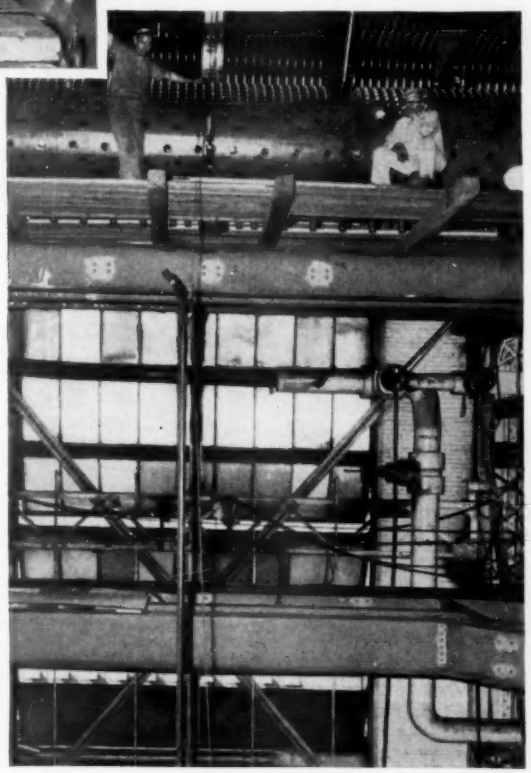
Every ELECTRUNITE Boiler Tube has identical metallurgical and physical properties. Because wall thickness is uniform, there are no longitudinal thin spots. This results in uniform heat transfer.



Surfaces of ELECTRUNITE Boiler Tubes are scale-free because they are normalized in a controlled atmosphere. This saves grinding tube ends which destroys uniformity. Tubes slide into drum holes easily, expand uniformly.

●

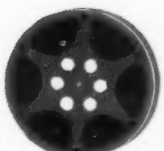
Because of ELECTRUNITE'S uniform ductility, accurate bends are easily made, and spring-back can be calculated before bending operation.



Rouge Plant

From the standpoint of economics, it pays to consider ELECTRUNITE Boiler, Condenser and Heat Exchanger Tubes. Write for the booklet that gives you complete data and specifications.

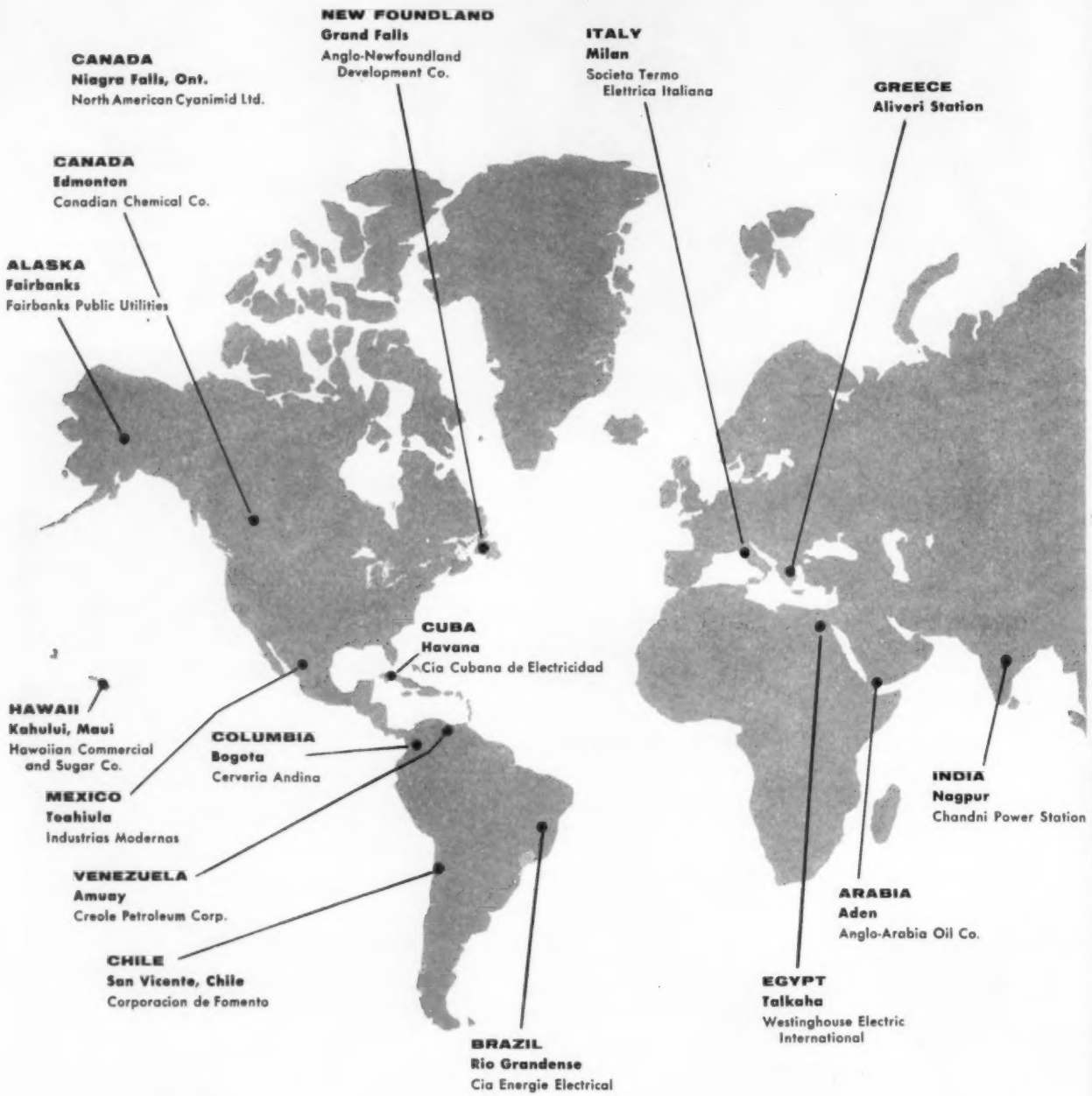
REPUBLIC STEEL CORPORATION
Steel and Tubes Division
221 East 131st Street, Cleveland 8, Ohio
GENERAL OFFICES • CLEVELAND 1, OHIO
Export Department: Chrysler Building, New York, 17, N. Y.



"INTESTINAL FORTITUDE"—16 mm., sound, black and white, 17 minutes. The story of ELECTRUNITE pressure tubes. A short introduction reviews the progress of the iron ore from mines to blast furnace. Then the various steps necessary to make the flat-rolled coils of steel from which the tubing is made. Finally, how ELECTRUNITE tubing is made. To arrange for showing, write to Steel and Tubes Division.

Republic
REPUBLIC STEEL
ELECTRUNITE
BOILER, CONDENSER AND HEAT EXCHANGER TUBES

Choose the Combustion Controls

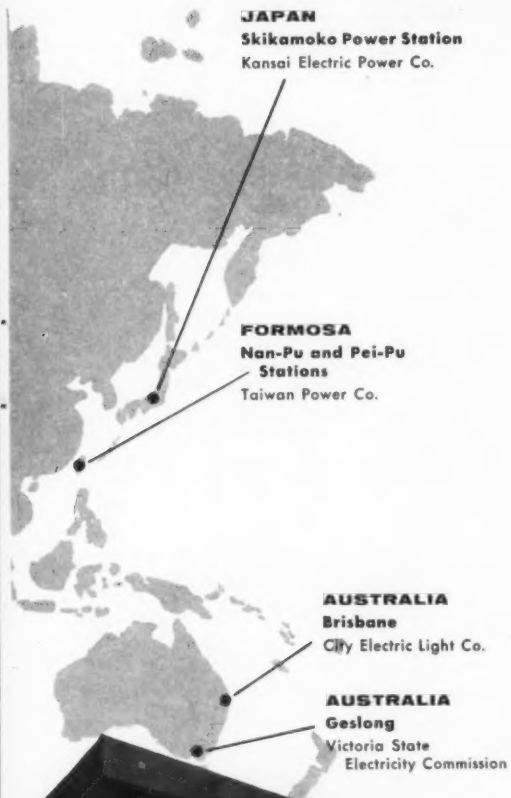


THIS IS ONLY A PARTIAL REPRESENTATION OF POWER PLANTS OUTSIDE OF THE UNITED STATES WHICH RELY ON REPUBLIC CONTROLS.

REPUBLIC FLOW METERS CO.

with a World-Wide Reputation

REPUBLIC *Automatic* COMBUSTION CONTROLS



Combustion efficiency is spelled and pronounced many different ways throughout the world. It's even expressed in two different units — pounds or kilograms of steam produced per unit of fuel consumed. No matter how you spell or measure it, however, its importance is the same to power plants everywhere — in ancient Peru or the distant Philippines.

To get maximum combustion efficiency in power plants all over the world, engineers have specified Republic Controls again and again. With Republic, they know they are getting an extra "plus" in dependability because Republic Controls are ruggedly built to match the high availability of other equipment in the plant.

In *your* plant, insure maximum combustion efficiency and dependability by specifying Republic. At your service is an engineering staff with more than 35 years of specialized experience in power plant control to help you design the system that best meets your needs.

REPUBLIC Automatic COMBUSTION CONTROLS

- **For all types and sizes of boilers**
- **For all types of fuel**
- **For all types of firing**
- **For all arrangements of draft**
- **For all load conditions**

2240 Diversey Parkway • Chicago 47, Illinois

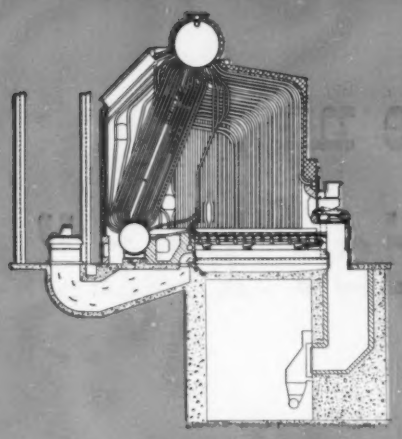
Two CP Diesels Keep The "Follies" on Ice

Here's an example of CP performance and reliability—a pair of Chicago Pneumatic Model 68 diesel engines that generate over an estimated 1,000,000 kwh a year for The New Haven Arena. Besides furnishing light and power for the entire arena consisting of auditorium, parking garage, service station, ice plant, block of stores, and executive offices, they also drive two 10 x 10 ammonia compressors for the manufacture of commercial ice in the summer and refrigeration for rink ice skating in the winter.

Rated at 180 hp, 600 rpm, these engines are typical of many CP installations where multiple power requirements call for absolute dependability and low operating cost. CP diesel, dual-fuel and gas engines are available in sizes capable of delivering from 120 hp to 1750 hp. For more details write *Chicago Pneumatic Tool Company, 8 East 44th Street, New York 17, New York.*

One of the two CP Model 68 diesel engines generating light and power for The New Haven Arena.

Chicago Pneumatic
PNEUMATIC TOOLS • AIR COMPRESSORS • ELECTRIC TOOLS • DIESEL ENGINES • ROCK DRILLS • HYDRAULIC TOOLS • VACUUM PUMPS • AVIATION ACCESSORIES



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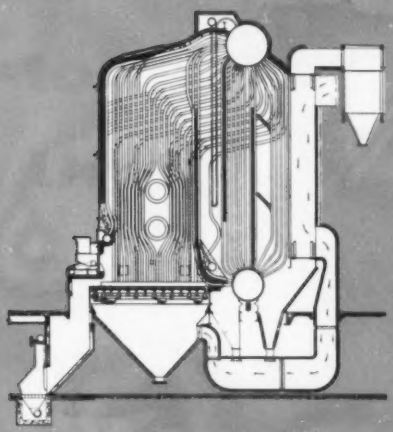

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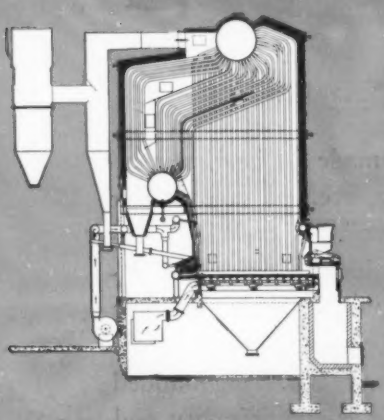

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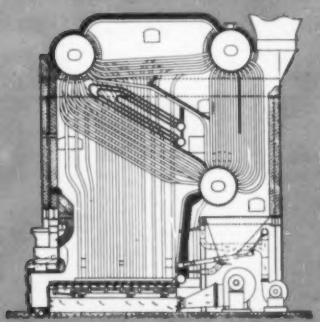


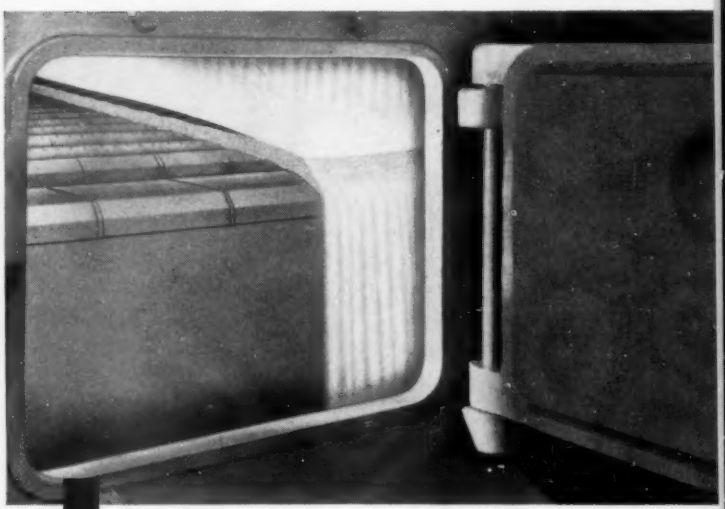
4.

EASILY APPLIED TO

new or existing boilers

Detroit RotoStoker type C-C

(continuous cleaning)



Popular because the reciprocating grate continuously discharges the ash, for easy removal through doors in the front at floor level or by conveyor.

May be applied to new or existing boilers of all types with low construction expense.

Smokeless operation assured through wide load range.

Detroit RotoStoker Type C-C efficiently burns Bituminous Coals and Lignite without special preparation.

Get full information on the Detroit RotoStoker Type C-C . . . Write for Bulletin 800. No obligation.

1. **Detroit RotoStoker Type C-C with Babcock & Wilcox Boiler—35,000 lbs. per hr.**
2. **Detroit RotoStoker Type C-C with Union Boiler—46,000 lbs. per hr.**
3. **Detroit RotoStoker Type C-C with Springfield Boiler —50,000 lbs. per hr.**
4. **Detroit RotoStoker Type C-C with Wickes Boiler—40,000 lbs. per hr.**

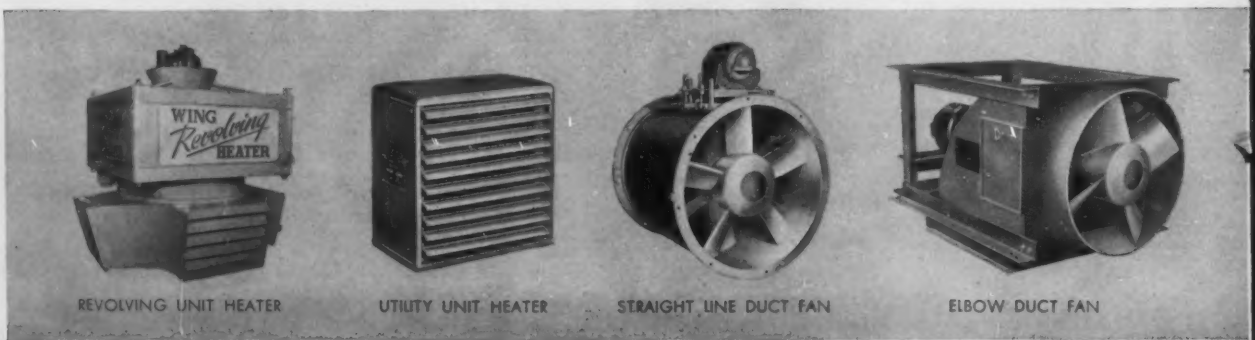
DETROIT ROTOSTOKER TYPE C-C

DETROIT STOKER COMPANY

GENERAL MOTORS BLDG., DETROIT 2, MICH. • Works at Monroe, Mich. • District Offices in Principal Cities

In 1879, it was the new "Wing's Disc Fan"

It was 75 years ago that L. J. Wing, an ingenious Yankee who had come to New York with some ideas about mechanical devices, formed the company which later became the L. J. Wing Mfg. Co., for the purpose of manufacturing and selling "Wing's Disc Fan" which, according to his catalog, would "move more air than any other Fan made for heating, ventilation, drying, etc., as competitive trials have shown". Today, Wing products for ventilation, heating and combustion are known for their efficiency and dependability in all parts of the world. The company Mr. Wing founded has kept his ideals of originality and excellence constantly before them.



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today, Wing Fans, Blowers, Unit Heaters, Draft Inducers and Turbines are serving industry the world over

OUR 75TH 1879-1954 YEAR

L. J. Wing Mfg. Co.

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FACTORIES:
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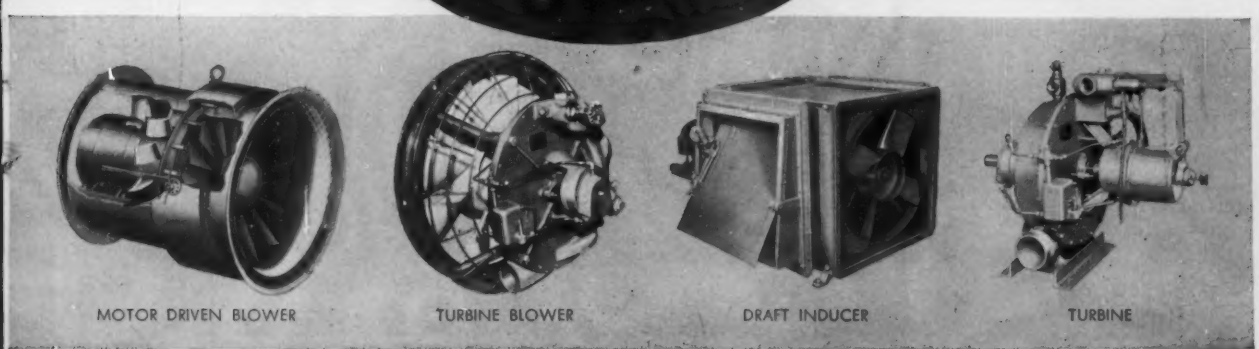
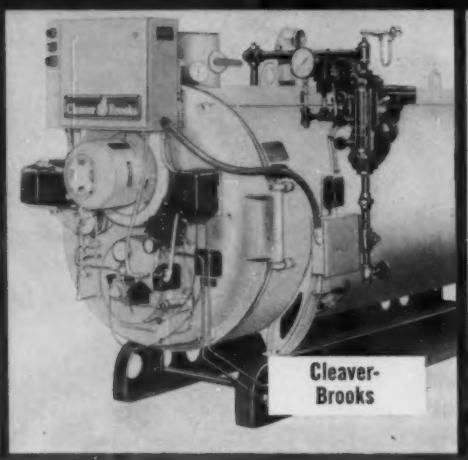
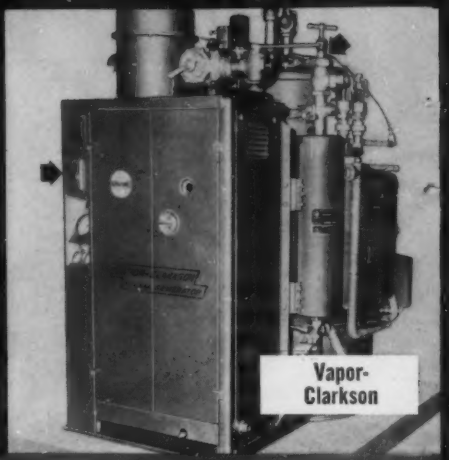
ETABLISSEMENT WANSON
BRUSSELS • BELGIUM

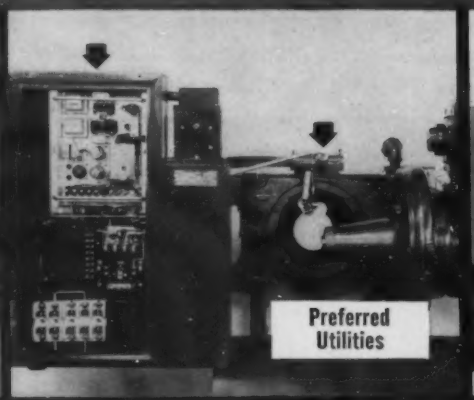


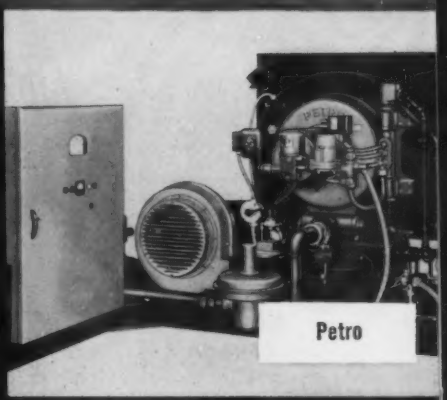
MOTOR DRIVEN BLOWER | TURBINE BLOWER | DRAFT INDUCER | TURBINE

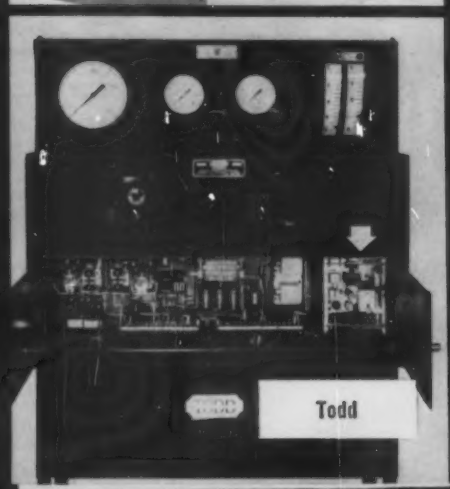


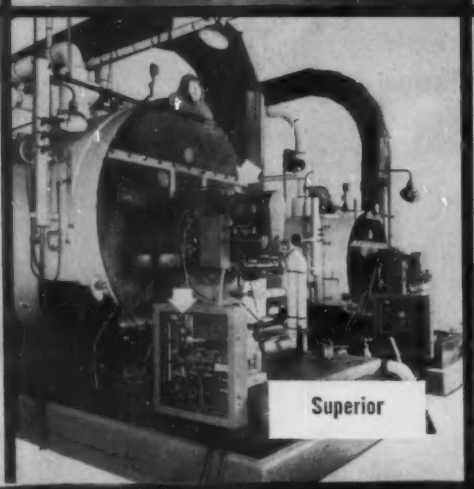


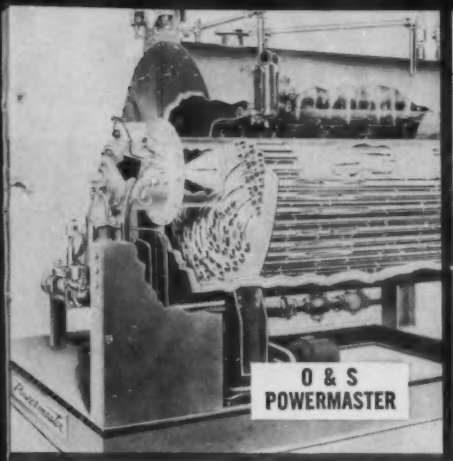
9 out of 10 packaged burners are equipped with...

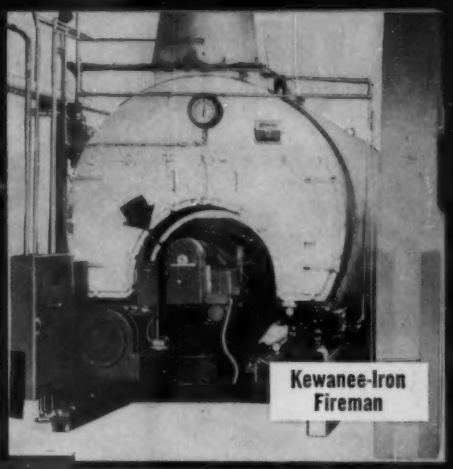












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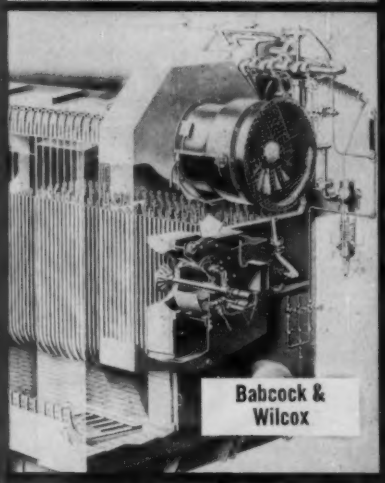
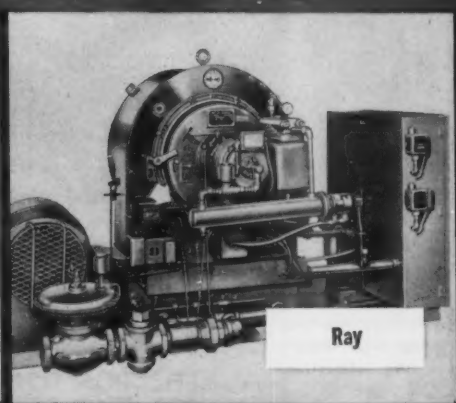
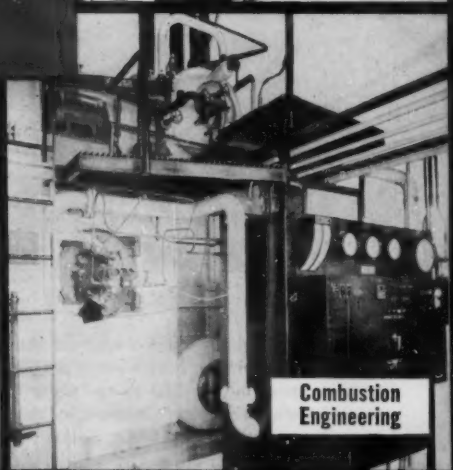
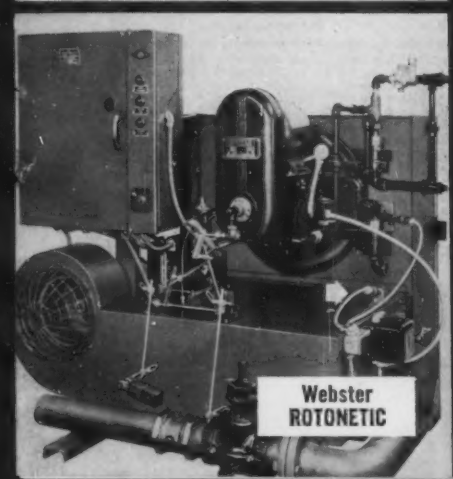
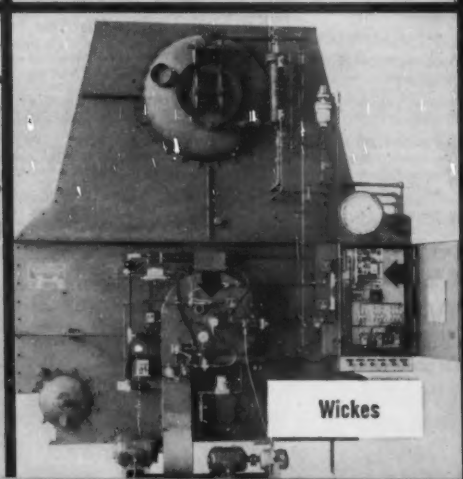
FLAME FAILURE PROTECTION

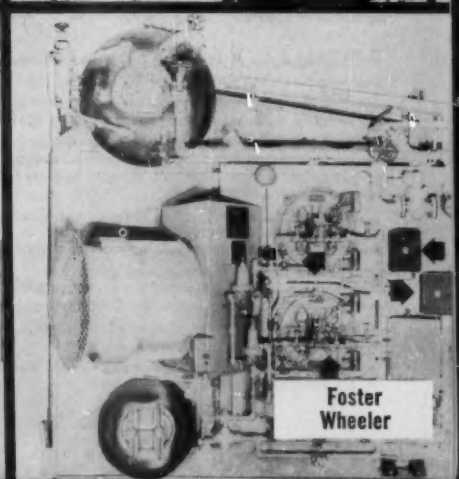




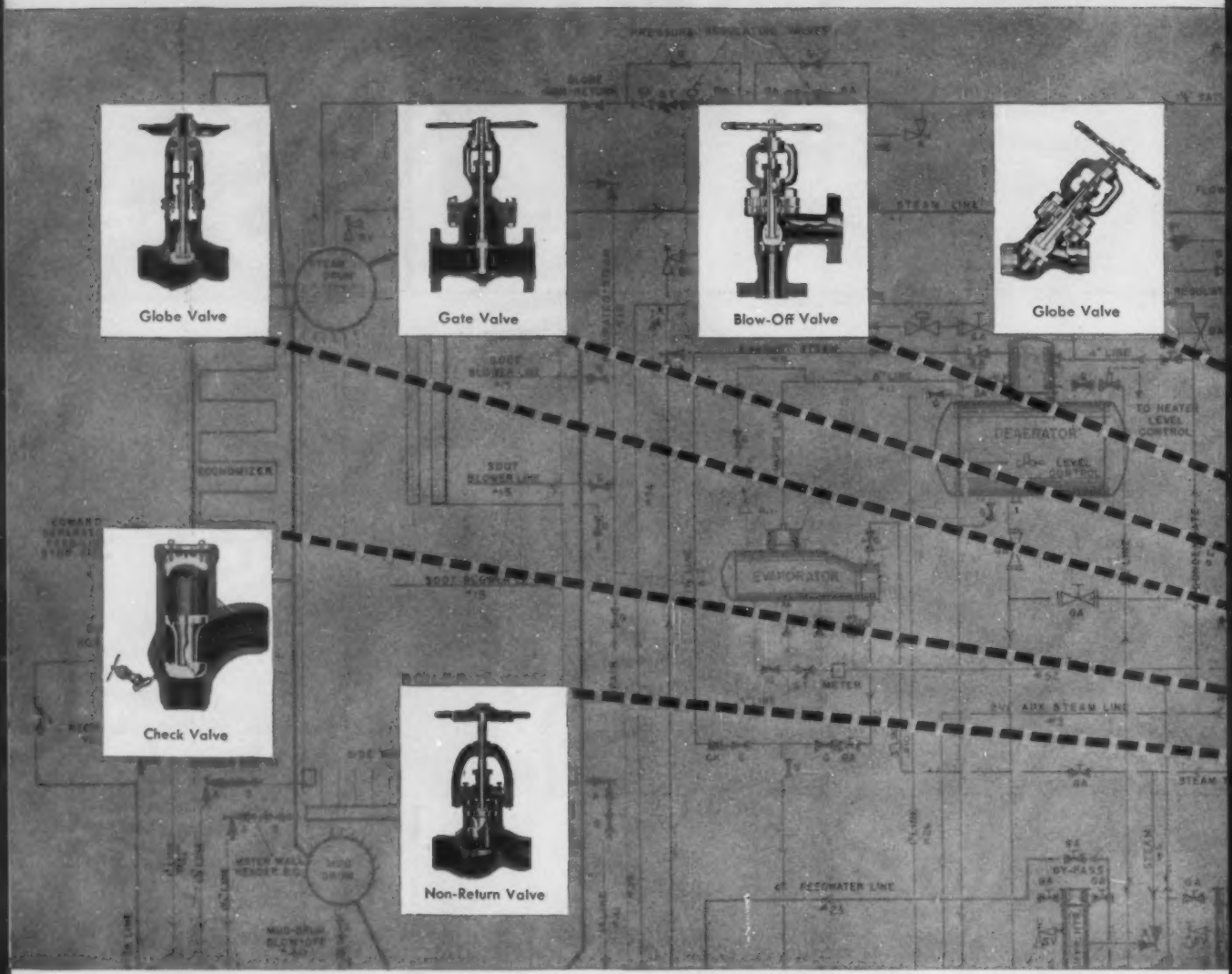








What you should know about



Fifty years ago Edward designed the first steel blow-off valves to solve the troublesome problem of blowing down boilers operating at 250 lb sp. Over the years continuous research and experience gained by solving valve problems have revealed many facts about steel valve selection, operation, maintenance and repair. Here are some of the most important.

INSTALLATION IDEAS . . . that can save money, increase piping and valve efficiency.

1 Consider using an angle valve in place of an elbow and a valve for reduced installation costs and operating convenience.

2 To hold valve expenditures to a minimum, use valves of standard construction and avoid high cost special designs. Presenting the problem to competent valve engineers such as those at Edward often results in money saving suggestions.

3 Wherever possible, install stop valves with the stem up to facilitate easy, quick lapping the seat. Considering maintenance and repair for each valve at the time of installation will reduce costs later.

4 Provide for convenient manual operation of ALL valves including non-return and motor operated valves, regardless of the frequency of the need for such operations, as a safety measure.

5 Install check valves and non-return valves so that pistons travel vertically to minimize danger of "hang-ups" or incomplete closures.

6 Reduce power consuming turbulence and wear in small forged valves by installing "inclined stem" valves.

7 For temperatures over 850°F welded bonnet or pressure-seal valves are more dependable.

8 Place strainers in lines to protect delicate, expensive gages, regulators, pumps, valves, traps, etc., to increase their dependability and cut future maintenance and replacement expense.

SELECTION POINTERS . . . that reduce maintenance cost and foster safe, dependable valve operation.

1 Always select the proper size valve for each service. Too small a valve has a high pressure drop and wastes power. Too large a valve requires more effort to operate and may cause excessive wear especially in check valves and non-return valves.

2 Stop valves that give positive shut-off regardless of the position of the valve make for greater efficiency and installation freedom.

3 Using modern type globe or angle valves in place of gate valves where drop-tight closures are required is recommended for repairability, tightness, adaptability and dependability.

4 In higher pressure-temperature services, several desirable features give pressure-seal valves distinct advantages over old style, heavily bolted bonnet designs. Here are a few:

(a) pressure-seal bonnets stay tight regardless of temperature-pressure variations;

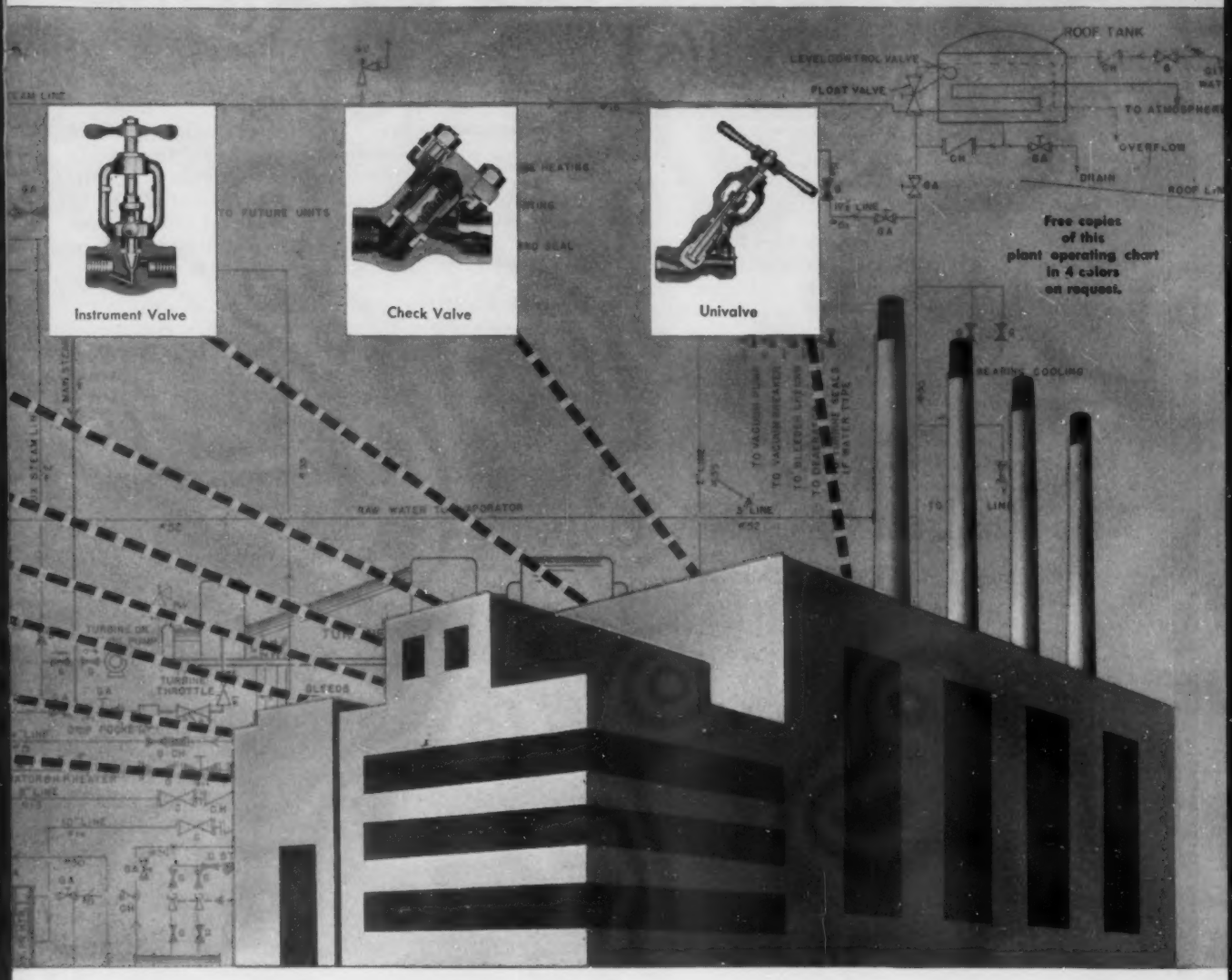
(b) fewer bolts, lighter covers and bonnets reduce maintenance costs;

(c) pressure-seal offers a higher degree of part interchangeability;

(d) lower pressure drop in streamlined pressure-seal designs permits use of smaller piping and valves . . . saving space, weight and costs;

(e) and pressure seal construction improves streamlining which reduces wear-inducing turbulence;

STEEL VALVES*



5 When selecting check valves, remember the piston type has at least five big advantages over the swing type:

(a) dashpot action of piston type check valves prevents slamming, eliminates damaging shock;

(b) disks give a tighter seal;

(c) more complete guiding minimizes vibration of moving parts;

(d) angle designs to replace elbows are possible in piston type check valves;

(e) disks can be easily re-lapped when necessary.

6 Piston type check valves and non-return valves give greater efficiency and more positive operation when the zone above the disk is connected to the outlet port to equalize the pressure in these areas. A connection such as the Edward Equalizer increases disk lift, cuts vibrations, reduces pressure drop.

7 Swivel disk construction with a self-centering feature on stop valves and blow-off valves eliminates seat-disk galling because the stem turns on disk rather than disk turning on the seat.

8 In blow-off service select sets in which both valves are the same type for dependable, drop-tight closing and interchangeability of parts and for repacking under pressure be sure both have positive backseats.

9 Gate valves with accurately aligned stem, guide ribs that prevent wedge drag and hard surfaced seats in bodies of uniform metal sections reduce maintenance. Hydrostatic testing of both sealing surfaces at the same time insures greater dependability.

10 By all means avoid gadgety designs. Long, dependable service with freedom from maintenance should be the primary consideration.

VALVE INDUSTRY STANDARDS... that are an outgrowth of the Edward "Firsts" in valve research and development.

1 FIRST steel blow-off valves.

2 FIRST Impactor handwheel to make manual operation of large valves easier.

3 FIRST inclined stem globe valve to reduce pressure drop and turbulence.

4 FIRST streamline internal contours to minimize pressure-loss.

5 FIRST Pressure-Seal non-return valves.

6 FIRST Equalizer for check and non-return valves to stop wear-producing vibrations and increase lift of disk piston.

7 FIRST bored-out, streamlined guide ribs for positive three-point guiding throughout disk travel.

8 FIRST Evalthrust ball-bearing yoke bushing construction for easier valve operation.

9 FIRST use of exclusive Evalizing electro-plating process to lubricate operating parts and protect them against corrosion.

The valves highlighted in this diagram are only a few of the complete line of cast and forged steel valves built by Edward.

Edward Valves, Inc.

Subsidiary of ROCKWELL MANUFACTURING COMPANY

1220 W. 144th ST.,
EAST CHICAGO, INDIANA

Another Product

2 BIG NEW 9600 H.P.

Talk about modern power plant operation . . . visualize a comfortable, air-conditioned control room, separated from the main engine room by plate glass, in which one operator scans special gauges, panels, warning lights and push-buttons . . . and from this one station, easily controls the operation of two of the largest Diesel engines ever built in the Western Hemisphere.

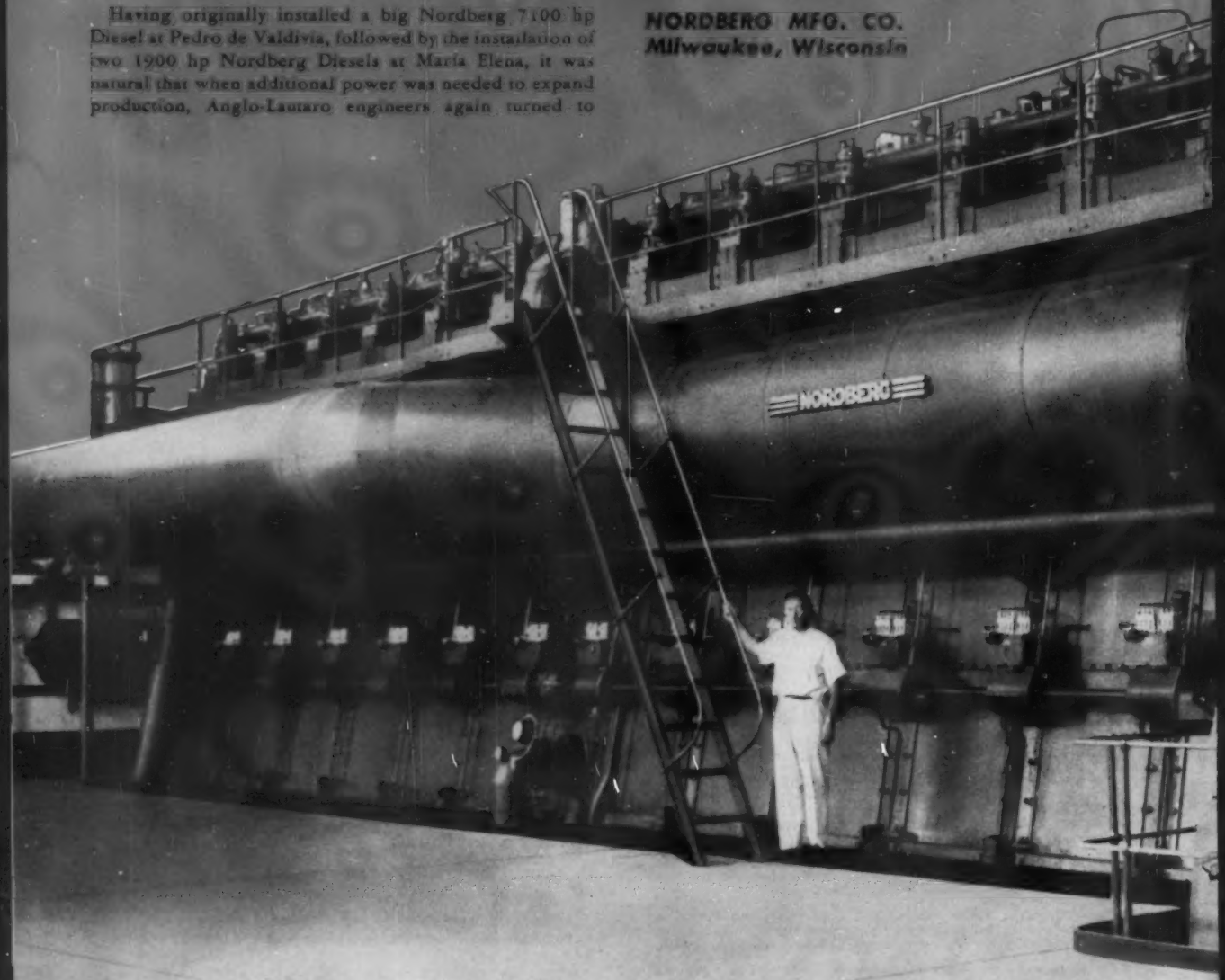
This is the story of the modern new Diesel power plant recently completed by the Anglo-Lautaro Nitrate Corporation at Coya Sur, in the heart of their vast nitrate operations, located between the María Elena and Pedro de Valdivia plants in northern Chile. The new Coya Sur power plant forms part of a three-plant network whose combined generating facilities provide a total of 46,000 kilowatts for nitrate production.

Having originally installed a big Nordberg 7100 hp Diesel at Pedro de Valdivia, followed by the installation of two 1900 hp Nordberg Diesels at María Elena, it was natural that when additional power was needed to expand production, Anglo-Lautaro engineers again turned to Nordberg for the efficient, economical solution to their current power problem.

The problem of providing the much needed additional power has now been confidently assigned to two 12-cylinder, 29" bore x 40" stroke Nordberg 2-cycle Diesel engines, each having a sea-level rating of 9,600 bhp, corresponding to 8,950 bhp at the installed altitude of 4,166 feet. Each big engine drives a totally-enclosed General Electric generator rated 8,750 kva, 7,000 kw at 80% P.F.

Employing not only two of the largest engines in the Western Hemisphere, but the most modern concepts of power plant design and operation, the new Coya Sur Diesel plant is a striking example of the way modern industry is being served by efficient, economical Nordberg Engines.

NORDBERG MFG. CO.
Milwaukee, Wisconsin

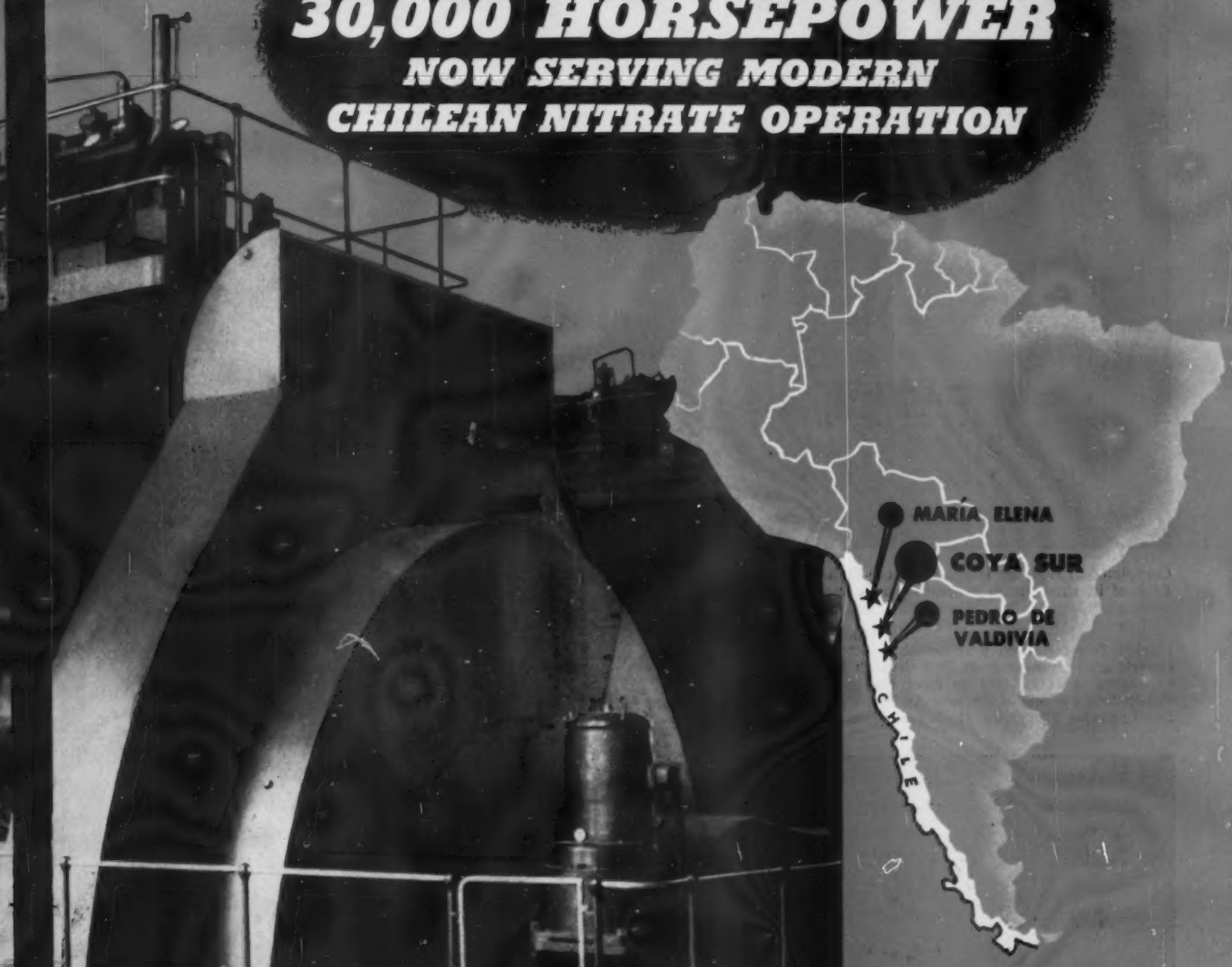


BUILDERS OF AMERICA'S LARGEST LINE OF HEAVY DUTY ENGINES . . . 10 TO OVER 10,000 H.P.

NORDBERG DIESELS

FOR ANGLO-LAUTARO NITRATE CORPORATION

FIVE NORDBERG DIESELS TOTALLING MORE THAN 30,000 HORSEPOWER NOW SERVING MODERN CHILEAN NITRATE OPERATION



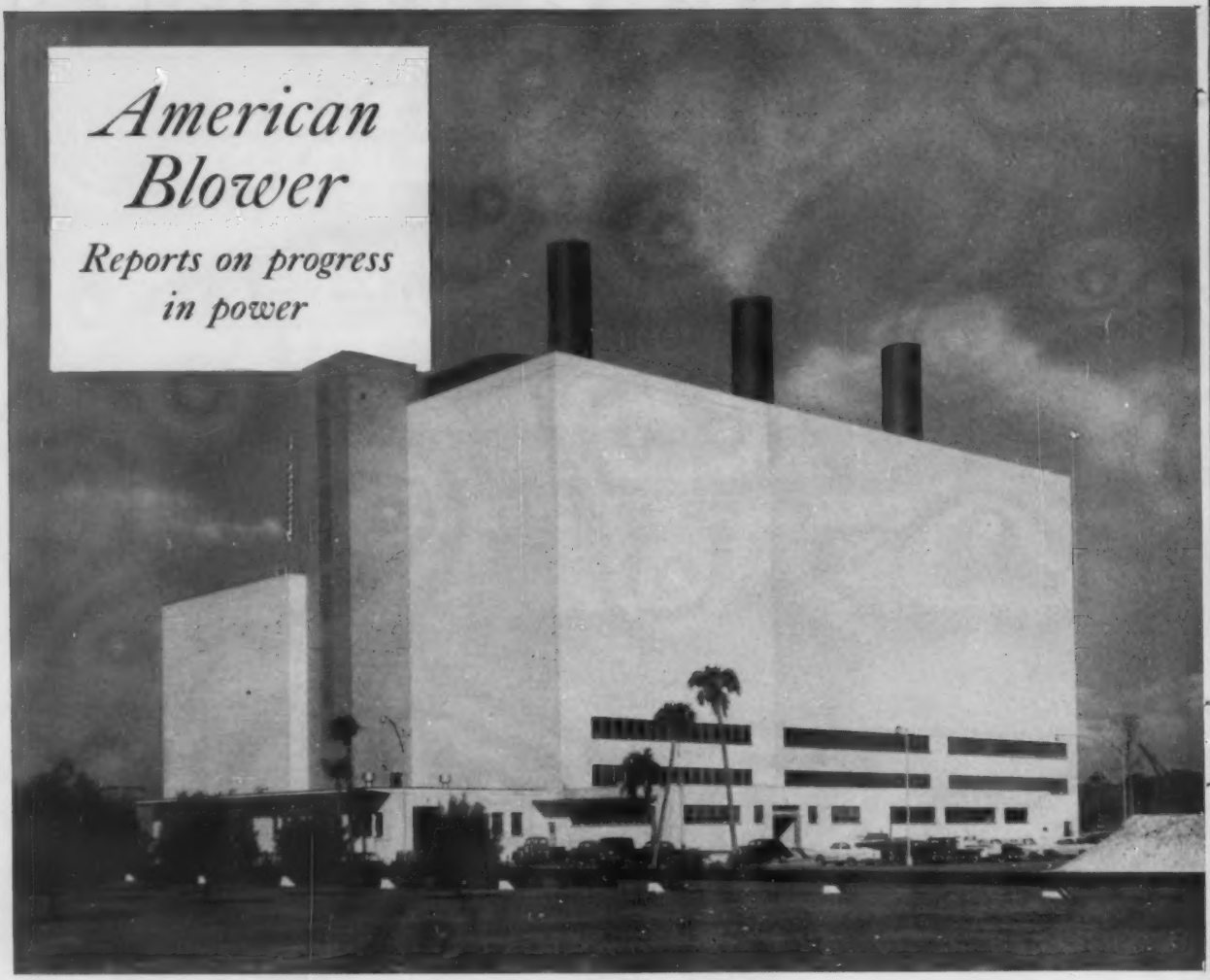
NORDBERG

DIESEL • DUAFUEL® AND SPARK-FIRED GAS ENGINES

P654

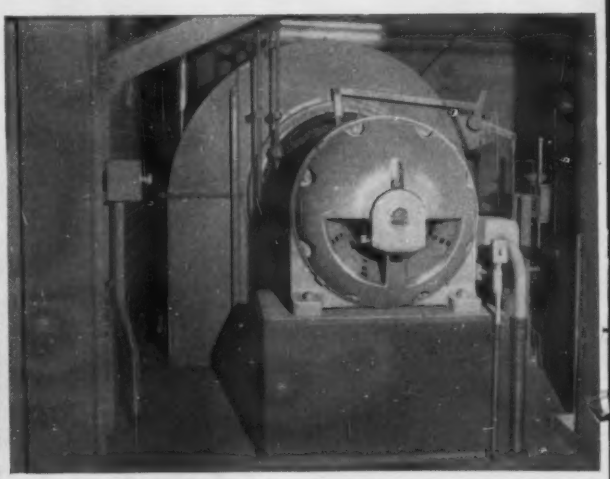
American Blower

Reports on progress in power



Completed in 1954, the Higgins Plant at Oldsmar, Florida has a capability of 135,000 kw. Each of its three steam generating units requires 550,000 barrels of fuel oil annually.

Florida Power showed a remarkable increase (279%) in electric sales revenues from 1942 through 1952. Continued expansion is anticipated to meet the growing demand. Shown below is one of the new American Blower Induced Draft Fans on #1 boiler at the beautiful new Higgins Plant.

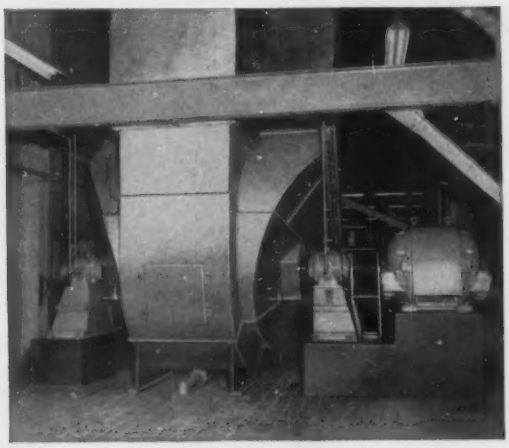


Also on Higgins #1 boiler is this American Blower Forced Draft Fan, rated at 81,400 cfm, 695 rpm, and 10.5" sp. Florida Power helps make the communities it serves good places to live and work.

Serving home and industry: **AMERICAN STANDARD** •

Florida Power Corporation keeps pace with rising needs for electricity

In 1897, the first plant of what is now the Florida Power Corporation went into operation with a wood-burning boiler and a 50 kw generator. Today, Florida Power and its subsidiary, Georgia Power and Light Company, serve 31 counties in Florida and 21 counties in Georgia. Total capacity is now 408,300 kw!



Here's another American Blower Sirocco Induced Draft Fan at the Higgins Plant. It is rated at 145,400 cfm, 695 rpm and 10.9" sp. Throughout the power plant industry American Blower's experience and know-how are helping plant operators solve their power plant problems.

Naturally, this continued expansion has been based on the growing needs of the area for low-cost electricity for homes, business and industry. Future needs are anticipated and planned for . . . years ahead of time.

Like other investor-owned utilities, Florida Power keeps output high and costs low by selecting dependable, efficient equipment — including American Blower Forced and Induced Draft Fans.

Power plant operators everywhere are specifying American Blower Mechanical Draft Fans, Dust Collecting Equipment, Fly Ash Precipitators and Gyrol Fluid Drive for boiler feed pump and fan control. They know they can depend on American Blower Equipment and American Blower technical assistance.

If you have an air handling problem, or are planning to expand or modernize, find out how American Blower can help you. Contact your nearest American Blower Branch Office, or write us direct.

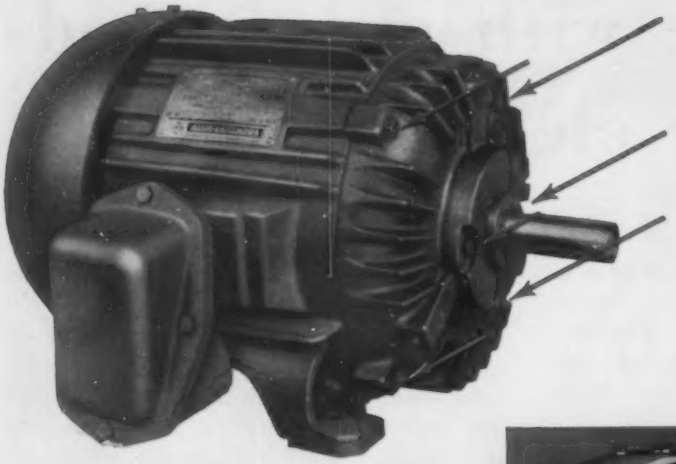
AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO
Division of American Radiator & Standard Sanitary Corporation

AMERICAN BLOWER

AMERICAN BLOWER • CHURCH SEATS & WALL TILE • DETROIT CONTROLS • KEWANEE BOILERS • ROSS EXCHANGERS • SUNBEAM AIR CONDITIONERS

Here's motor superiority

you can see

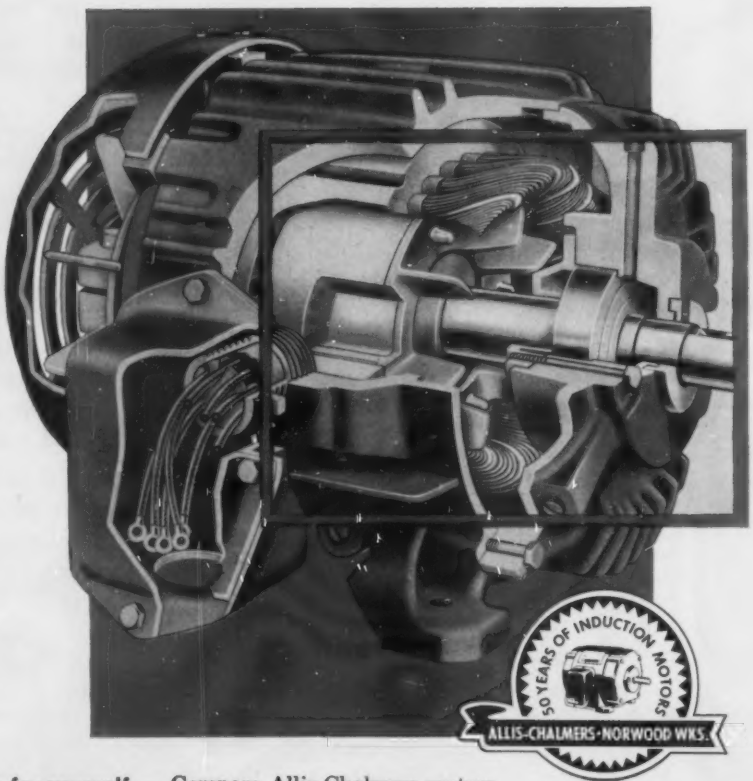


It takes 6 bolts not just 4 to give full bearing protection

THE TWO EXTRA BOLTS in the end housing of every Allis-Chalmers ball bearing motor are the proof of *extra* protection against bearing failure. These are the bolts that hold the bearing cap tightly in place against the inner face of the bearing enclosure. This cap, with its close running clearances, keeps grease from the interior of the motor . . . retains an ample supply within the bearing enclosure . . . protects the grease and the bearing against contamination from dirt and moisture.

At the outer side of the bearing, double labyrinth seals keep grease in, also keep dirt out. What's more, large grease reservoirs act as additional dirt traps.

Result? Allis-Chalmers motors pay off in longer, trouble-free bearing life, lower motor maintenance.



Get all the facts . . . judge for yourself — Compare Allis-Chalmers motors with other motors. Get the six-bolt construction that gives you complete bearing protection. For proof, see your Allis-Chalmers Office or Authorized Distributor, or write — Allis-Chalmers, Milwaukee 1, Wisconsin.

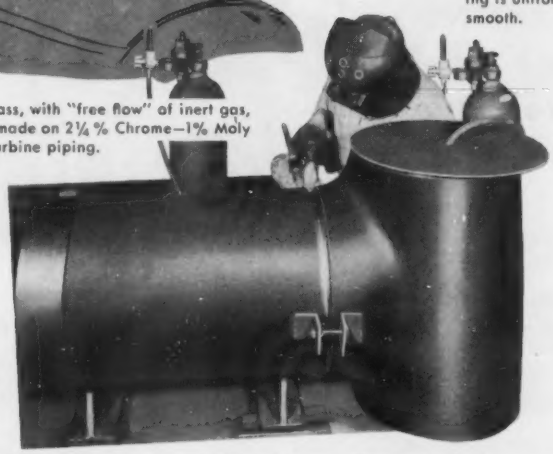
ALLIS-CHALMERS

A-C ALLIS CHALMERS

A-4441

INERT GAS TUNGSTEN ARC-WELDING ON HIGH-TEMPERATURE, HIGH-PRESSURE PIPING?

It's More a Matter of Skill Than Inert Gas Back Pressure



Root pass, with "free flow" of inert gas, being made on 2¼% Chrome—1% Moly steel turbine piping.

Inside bead surface of root pass on 2¼% Chrome—1% Moly steel turbine connection produced by P.P.&E. inert gas tungsten arc-welding is uniform and smooth.

Typical external surface of root pass produced by skillful inert gas tungsten arc-welder.

Inert gas tungsten arc-welding is one of many operations involved in the fabrication of high-temperature, high-pressure piping. Like the others its success is not assured by a single factor, but comes as a result of long experience with all manufacturing techniques and service requirements of power piping.

Simply protecting the internal surface of the root bead with inert gas under "control" does not take the place, for example, of skillful welding.

Pittsburgh Piping's process provides an inert gas shield against the atmosphere on both internal and external surfaces of the root pass. This procedure, combined with other P.P.&E. techniques, eliminates need for backing rings and double butt welding, and produces a sound, clean joint having a remarkably uniform root bead of correct internal contour.

Applicable to all types of power and process piping—inert gas tungsten arc-welding is another of the many advanced P.P.&E. techniques used in producing all types of power piping —as small as control lines, as large as steam mains.

Pittsburgh Piping AND EQUIPMENT COMPANY

10 Forty-Third Street—Pittsburgh, Penna.

Atlanta.....Whitehead Building	Cleveland...Public Square Building
Boston.....10 High Street	Houston...Heights State Bank Bldg.
Charlotte.....221 Builders Building	Los Angeles.1830 N. Alexandria Ave.
Chicago.....Peoples Gas Building	New Orleans.....P. O. Box 74

New York.....Woolworth Building

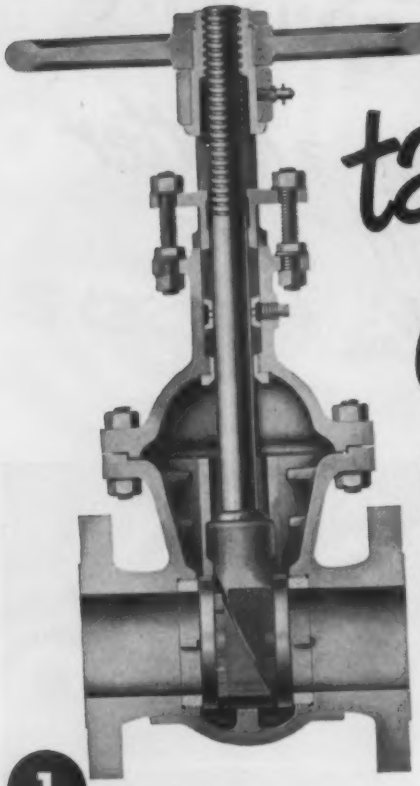
PP-5

PLUS VALUES, JOB-PROVED AGAIN AND AGAIN

DARLING VALVES

take your choice...

FOR BETTER, LOWER COST SERVICE WITH DARLING cast steel gate valves



1

2

DARLING VALVES FOR EVERY NEED

Darling gate valves are made in a wide range of sizes, types and constructions for all kinds of normal and unusual service . . . and for pressures up to 1500 pounds.

IN addition to gate valves of solid wedge design, Darling offers two other types. Both have distinctive features that prolong valve life while minimizing down time and maintenance. They're great time and money savers! . . .

1 This view shows a Darling gate valve of the fully revolving, double disc, parallel seat type. Time and again users rate it the most trouble-free, best performing gate valve obtainable today. Why? Because its unique design assures: *automatic* adjustment for valve body distortion . . . positive, easy operation . . . uniform wear distribution . . . foolproof simplicity in maintenance and reassembly . . . and service life seldom if ever equalled.

2 Take a close look at the slotted, double-grooved wedge in this cutaway view. There's little wear and tear on *these* wedge faces and seats because the slot permits compression of the wedge to compensate for valve body expansion or contraction due to temperature changes. Moreover, the double grooves, with twin guide ribs in the valve body, provide twice the usual bearing area, eliminating wedge canting and avoiding damage to the downstream seat.

SEND FOR BULLETIN

Why not get *all* the facts on these money-saving valves? Then *you* can analyze and decide whether or not you stand to gain by giving Darlings a try. Simply specify your service requirements . . . or ask for cast steel valve bulletin.

DARLING VALVE & MANUFACTURING CO.

Williamsport 8, Pa.

Manufactured in Canada by Sandilands Valve Manufacturing Co., Ltd., Galt 19, Ont.

AN "O" RING
for every purpose
EFFECTIVE SEALING

DISTRICT OFFICES

BALTIMORE, MD.
BOSTON, MASS.
BUFFALO, N. Y.
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DAYTON, OHIO
DETROIT, MICH.
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INDIANAPOLIS, IND.
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MILWAUKEE, WIS.
MONTREAL, CANADA
NEW ORLEANS, LA.
NEW YORK, N. Y.
PHILADELPHIA, PA.
PITTSBURGH, PA.
SAN FRANCISCO, CAL.
SEATTLE, WASH.
SPOKANE, WASH.
ST. LOUIS, MO.
TOLEDO, OHIO
WILMINGTON, CAL.

Ankorite "O" rings provide effective sealing through a range of pressures, temperatures and movements. When properly applied they exert low running friction on moving parts.

Ankorite "O" rings are accurately molded to close tolerances from compounds of natural rubber, Ankoprene, Buna N, Thiokol, Silicone, etc.

They offer many advantages:

1. Production cost is reduced by elimination of complicated assemblies.
2. Special assembly tools are not necessary.
3. Economical to use since only one "O" ring is required on piston or rod.
4. Long life, fluid-tight packing is assured with correct design and machining of grooves and mating parts.

"O" ring gaskets used as static seals have been known to withstand pressures as high as 15,000 p.s.i. In most other applications "O" rings are suitable to pressures up to 2,000 p.s.i. where radial clearances do not exceed .003".

THE ANCHOR PACKING COMPANY

GENERAL OFFICES: PHILADELPHIA, PA.
FACTORIES: MANHEIM, PA. ELKHART, IND. MONTREAL, CAN.

FIBROUS AND METALLIC PACKINGS FOR EVERY INDUSTRIAL PURPOSE

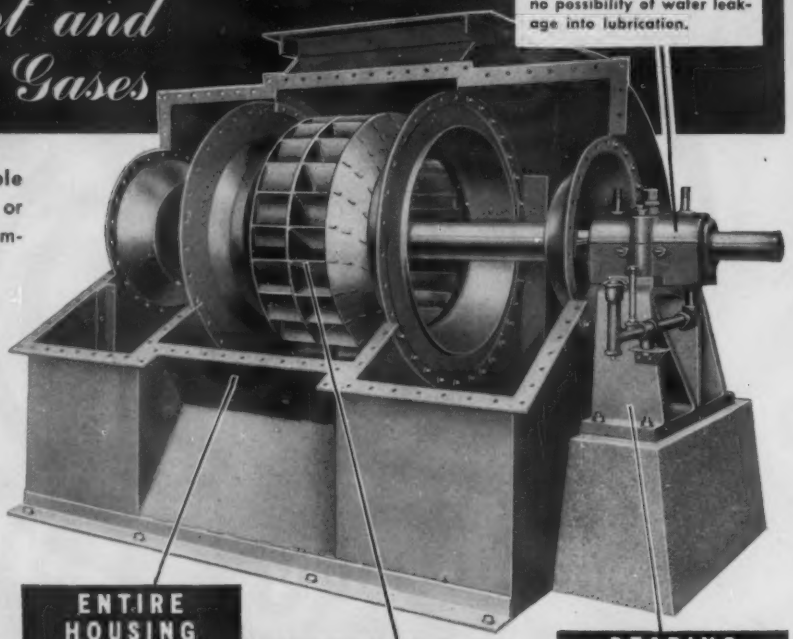
LONG EXPERIENCE

Handling Hot and Medium Hot Gases

You need the BEST fans obtainable — if your job is mechanical draft — or you require high or medium high temperature fans in production.

Fans built by Clarage for these tough jobs are heavier throughout—wheels statically and dynamically balanced, bearings of superior design. Operating economy and longer service without repairs are the natural results.

You do BETTER when you come to Clarage with any problem in this specialized field.

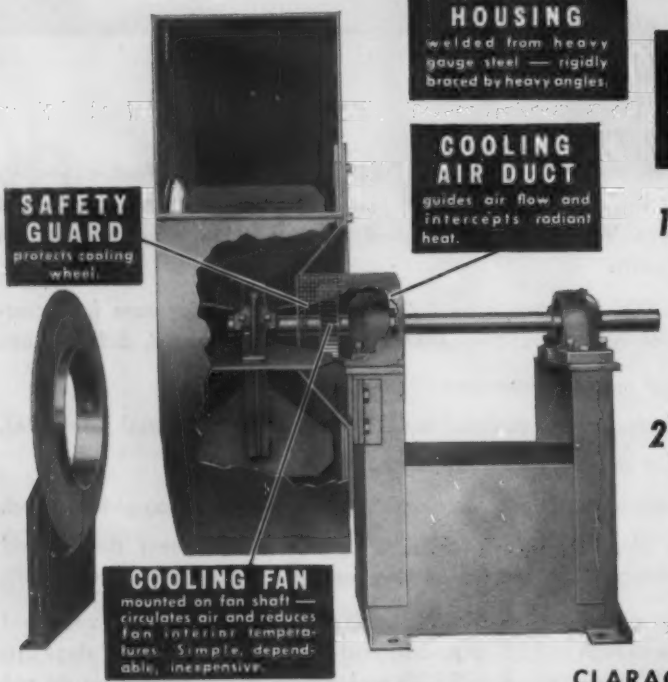


WATER COOLED BEARING
water circulated through each half of inner sleeve — no possibility of water leakage into lubrication.

ENTIRE HOUSING
welded from heavy gauge steel — rigidly braced by heavy angles.

FAN WHEEL
practically one piece welded assembly — with nearly twice the strength of wheels with shallow blades.

BEARING SUPPORT
massive cast iron structure provides permanent alignment to bearings, wheel and shaft.



SAFETY GUARD
protects cooling wheel.

COOLING AIR DUCT
guides air flow and intercepts radiant heat.

COOLING FAN
mounted on fan shaft — circulates air and reduces fan interior temperatures. Simple, dependable, inexpensive.

1) *High Temperature Fans*

Type RT fan (shown above with quarter-section removed) is built to handle air or other gases at any temperature required in power plant work, and to meet many industrial needs. Superior design assures sustained high efficiency, and superior construction makes for trouble-free service far beyond ordinary standards.

2) *Medium Temperature Fans*

Clarage has a unique feature — AIR COOLED bearings which are good for continuous operation at temperatures to 750° F. Air Cooled bearings are highly successful, easy to maintain, and they reduce overall fan cost substantially.

Clarage Air Cooled bearings can be used with absolute confidence.

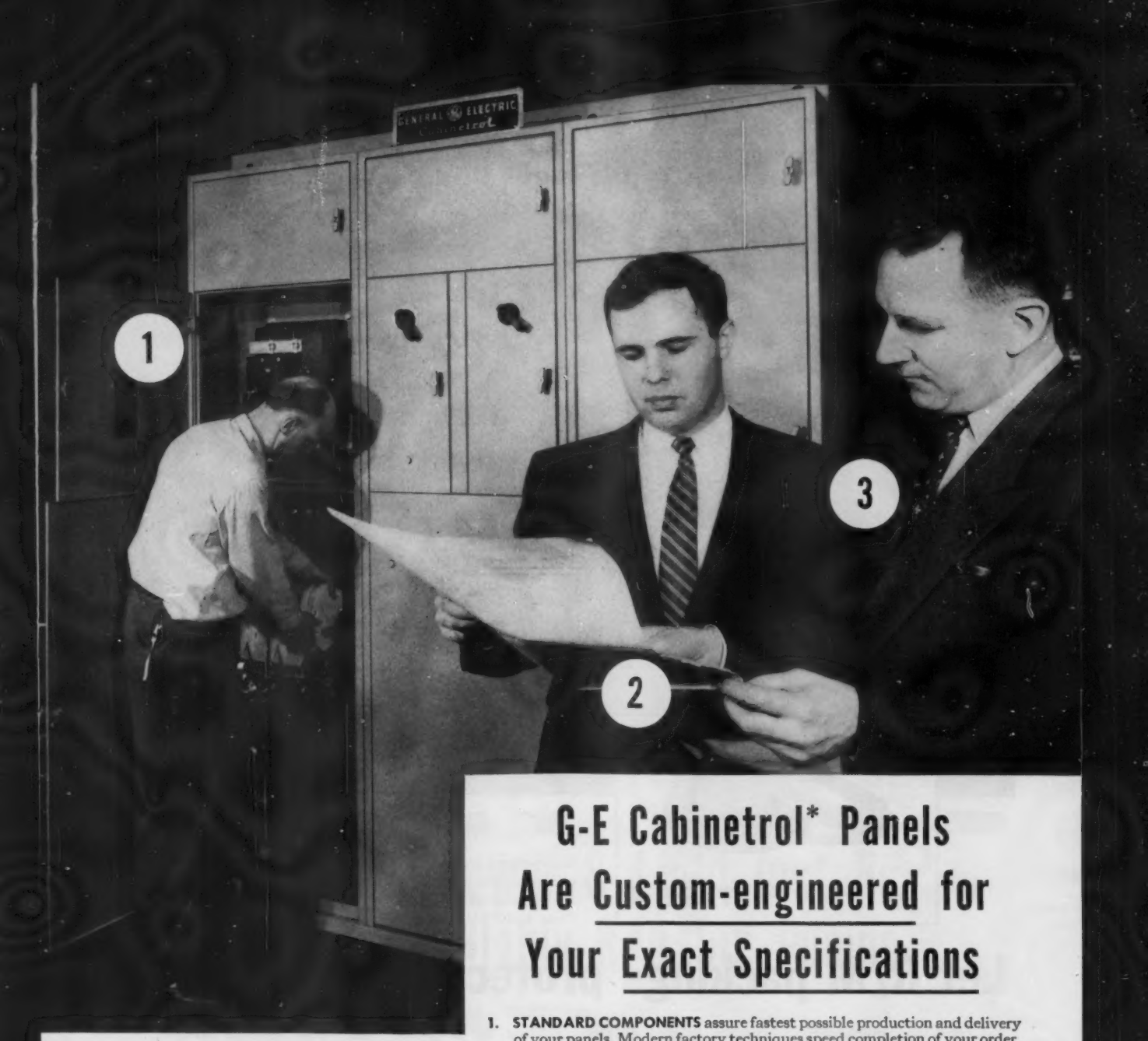
CLARAGE FAN COMPANY, *Kalamazoo, Mich.*

You can Rely on...

CLARAGE

Headquarters for Air Handling and Conditioning Equipment

SALES ENGINEERING OFFICES IN ALL PRINCIPAL CITIES • IN CANADA: Canada Fans, Ltd., 4285 Richelieu St., Montreal



G-E Cabinetrol* Panels Are Custom-engineered for Your Exact Specifications

1. **STANDARD COMPONENTS** assure fastest possible production and delivery of your panels. Modern factory techniques speed completion of your order.
2. **YOUR REQUIREMENTS** are followed exactly. Thorough examination and testing assure "job-tailored" performance.
3. **EXPERIENCED G-E ENGINEERS**—working closely with you—design the unit to meet your application.

Cabinetrol panels are not costly, improvised modifications of some other type of control center. These panels form a **standard** low-voltage control system which handles all motor types up to 600 hp from a central location. You get the time-saving and money-saving advantages of standard components which are custom-assembled.

For complete information, contact your nearest G-E Apparatus Sales representative. Or write for the descriptive bulletin, GEA-3856. Section 780-4, General Electric Company, Schenectady 5, New York.

*Reg. trade-mark of General Electric Co.

GENERAL ELECTRIC

R/M's BIG 7 Packing Types meet 95% of all packing needs

TYPE 4

Rotary pumps like this one, which handles 10 gallons of highly viscous materials (10,000 SSU) per minute at 1200 rpm, give top performance with R/M No. 376, a packing included in Type 4 of R/M's Big 7 Packing Types.

Let R/M packings protect your machines

Increased machinery protection is one of the very real advantages you get when you standardize on R/M's Big 7 Packing Types. The reason is that they're engineered to give custom-built performance in all but the very rarest packing applications. You can also count on this basic line of just seven field-tested packings to lower your maintenance costs, cut your downtime, reduce your inventories, and simplify your ordering. It will enable you to practice preventive rather than corrective maintenance. The entire requirements of your plant can probably be met with just three or four of R/M's Big 7 Packing Types. For details, see your R/M distributor.

R/M PACKINGS FOR MAINTENANCE PURPOSES ARE SOLD ONLY THROUGH AUTHORIZED R/M DISTRIBUTORS

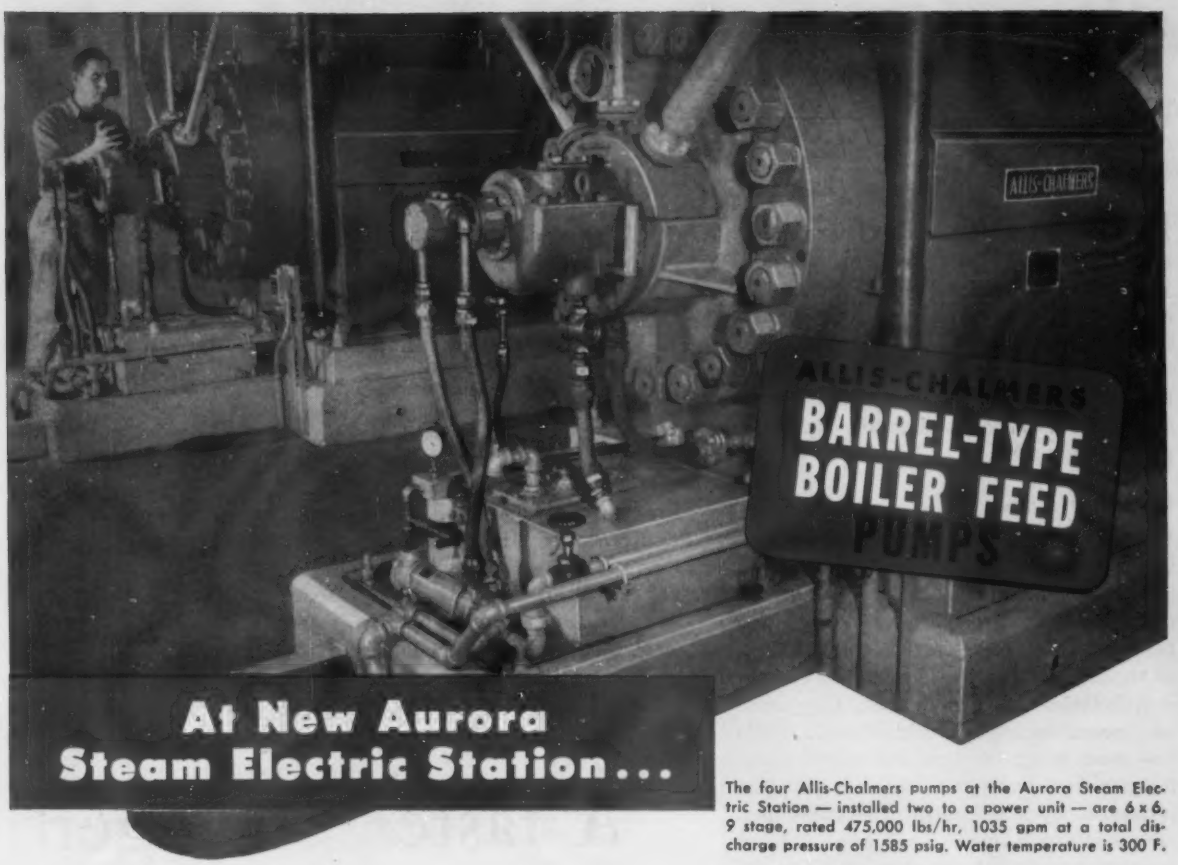
R/M

RAYBESTOS-MANHATTAN, INC., PACKING DIVISION, MANHEIM, PA.

BIG 7 PACKINGS

FACTORIES: Bridgeport, Conn.; Manheim, Pa.; No. Charleston, S.C.; Passaic, N.J.; Neenah, Wis.; Crawfordsville, Ind.; Peterborough, Ontario, Canada.

RAYBESTOS-MANHATTAN, INC., Packings • Asbestos Textiles • Industrial Rubber, Engineered Plastic, and Sintered Metal Products • Abrasive and Diamond Wheels • Rubber Covered Equipment • Brake Linings • Brake Blocks • Clutch Facings • Fan Belts • Radiator Hose • Bowling Balls



At New Aurora Steam Electric Station...

The four Allis-Chalmers pumps at the Aurora Steam Electric Station — installed two to a power unit — are 6 x 6, 9 stage, rated 475,000 lbs/hr, 1035 gpm at a total discharge pressure of 1585 psig. Water temperature is 300 F.

Minnesota Power & Light Installs 4 of these Highly Reliable Pumps

THE NEW 88,000-KW AURORA STEAM ELECTRIC PLANT at Aurora, Minn., is a model of modern design and efficiency. Equipment was carefully chosen for its ability to provide extra dependable, low-cost operation.

On this basis Minnesota Power & Light Co. — working with its consulting engineers, EBASCO SERVICES INCORPORATED — bought four Allis-Chalmers barrel-type boiler feed pumps.

WHAT ARE YOUR PUMP NEEDS?

Whether you require boiler feed, condensate, circulating or other power plant pumps — a careful study will reveal why more and more utilities are specifying Allis-Chalmers. Check the design features, the operating advantages, the provisions that make a pump easier to maintain, or service. You, too, will find it pays to standardize on Allis-Chalmers Power Plant Pumps.

ONE SOURCE FOR THE ENTIRE UNIT

Allis-Chalmers can supply the complete unit of pump, motor and control — all of coordinated design and manufacture. And you get one responsibility, one reliable guarantee of satisfaction covering the whole unit. A-4407

For detailed information, call your A-C district Office or write Allis-Chalmers, Milwaukee 1, Wisconsin. Ask for bulletin 08B7899.

ALLIS-CHALMERS

Service . . . where and when you want it

PROMPT, experienced service is one of the most important plus values you get when you buy Honeywell instruments. An unequalled organization of trained specialists is always at your call at more than 110 offices in the United States and Canada. Offices are located in practically every large industrial city of the country . . . close to every major production center.

Trained Personnel

Honeywell service men are schooled not only in the theory of measurement and control, but also in the practical art of keeping good instruments in the best condition. Hand picked men begin this instrument education in an intensive training program in Honeywell factories. After graduation, they serve an apprenticeship in the field offices . . . while they learn still more about instrument maintenance from first-hand contact with plant problems. By the time a Honeywell man arrives at your plant on a call, he's a finished product worthy of the responsibility he bears, and capable of doing the kind of service job that you need . . . and that your Honeywell instruments deserve.

When trouble strikes, a wire or telephone call will bring a service man to your plant . . . often within a few hours. This assurance of prompt action means a lot to your production schedules. You'll never be left out on a limb because of delays in instrument maintenance.

Periodic Service Plan

But why wait for emergencies? Preventive medicine works on instruments, too. And the prescription is simple . . . a Periodic Service Contract, which brings a Honeywell service man to your plant at regular intervals to inspect, clean and adjust any Honeywell instruments you have. The plan is economical . . . can save you many hours of lost production time. Your nearest Honeywell office will be glad to give you full details.

A faster, stronger *for steam*

TRAINED TO SERVE: *In Honeywell's service school, students get a thorough grounding in instrument theory and practice. After graduation, they become part of the most extensive organization of its kind in the world . . . ready to serve you competently and promptly, whenever and wherever you need them.*

FOR getting high-speed, precise measurements of steam temperatures, the Brown butt-welded thermocouple is the ideal partner for *ElectroniK* instruments. This thermocouple's unique characteristics come from an entirely new kind of design, in which the two couple wires are electrically welded together in a butt joint.

The thermocouple is *faster*—because the mass of the junction is much smaller than the usual twisted joint. It's *stronger*—withstands vibration and shock better. And it's *more accurate*—because the loop formed at the joint prevents heat conduction from the junction back to the insulators.

A wide line of thermocouple wells is supplied for various steam plant applications . . . including a series especially designed for high pressure steam lines. All Brown thermocouple wells are precision-machined to highly uniform wall thickness, to guarantee dependability at high temperatures and pressures. They are available in a broad choice of standard sizes and designs, supplemented by special types made to individual specifications.

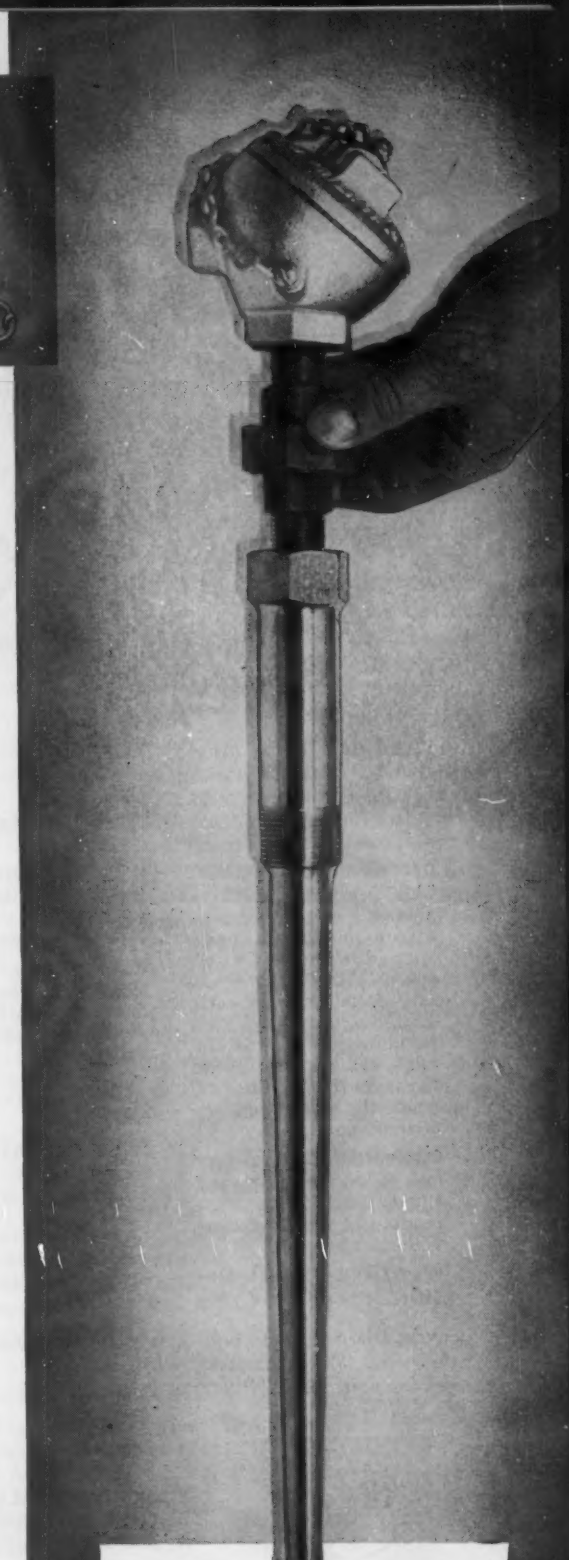
thermocouple *plant temperatures*

For specifying and purchasing all instrument supplies and accessories, you'll find new convenience and economy in the Honeywell Supplies Man—HSM—Plan. Your local HSM will be glad to explain the plan in detail, and to show you how planned buying can save you time and trouble. Call him today . . . he is as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, 4490 Wayne Ave., Philadelphia 44, Pa.

● **REFERENCE DATA: Write for Pyrometer Supplies Buyers' Guide No. 100-4 . . . and for Specification Sheet No. 200-2 on Thermocouple Wells.**

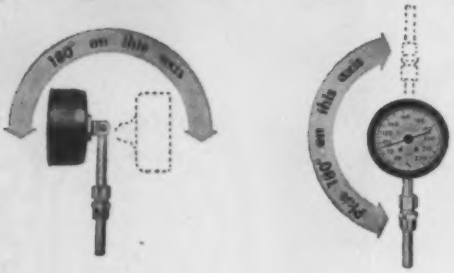
MINNEAPOLIS
Honeywell
BROWN INSTRUMENTS
First in Controls



STEAM THERMOCOUPLE *has tapered stainless steel well, precision-drilled to highly uniform wall thickness. Inset shows butt-welded thermocouple junction. The small mass gives fast response . . . curved wires prevent heat conduction away to the insulators.*

Better ANY WAY YOU LOOK AT IT...

AMERICAN "*Every Angle*" DIAL THERMOMETER



The American "Every Angle" Dial Thermometer is easy to install and turn to any position for accurate face-to-face readings. Specify the "Every Angle" — indoor or outdoor design — and this unbeatable feature combination is yours:

DEPENDABLE ACCURACY. The "Every Angle" Thermometer is made of precision-machined, non-corrosive materials and operates by vapor pressure. It is precisely calibrated against certified standards to assure the most critical reading in the upper third of the dial, where the graduations are farthest apart.

CONVENIENCE. Dial face can be rotated 180° and tilted 180° for accurate reading at the most convenient angle.

WEATHER-PROOF DESIGN. *Screw-type ring* with tight-fitting gasket for weather-proof outdoor service; *slip ring* design for indoors.

REINFORCED MOUNTING. Heavy-gauge swivel hinge has a *stainless steel kingpin.* Reinforced connection between hinge and bulb. Greater strength and corrosion resistance, long service life!

EASY INSTALLATION. Socket connections have compression-type bushings. No costly jigs needed — connection easily welded to tanks or other irregular-shaped equipment.

Ask your Distributor to help you select the American "Every Angle" Dial Thermometers with the proper temperature ranges for your needs. Phone or write him today.

SPECIFICATIONS

NON-CORROSIVE DIAL CASE: Non-corrosive aluminum with smooth black finish. No protruding screw heads. Nickel-plated brass cup houses coiled capillary tubing.

DIAL: 3½" diameter. White with black figures. **POINTER:** Black, adjustable. **FRONT:** Heavy plate glass. **MOVEMENT:** Bronze or stainless steel. **BULB AND STEM:** Stainless steel. **SIZE CONNECTION:** ½", N.P.T. **STEM-LENGTHS:** 3", 5-5/16", 12", 18" and 24". **SEPARABLE SOCKETS:** Bronze, carbon steel or stainless steel.

STANDARD RANGES

Fahrenheit	
—60 to 20°	30 to 300°
—20 to 120°	100 to 300°
40 to 140°	90 to 350°
30 to 180°	190 to 390°
20 to 220°	260 to 450°
Centigrade	
0 to 100°	40 to 150°

YOUR INDUSTRIAL DISTRIBUTOR makes it his business to see that you get the best possible equipment. That's why he handles only products of proved quality and dependability — like Manning, Maxwell & Moore products.

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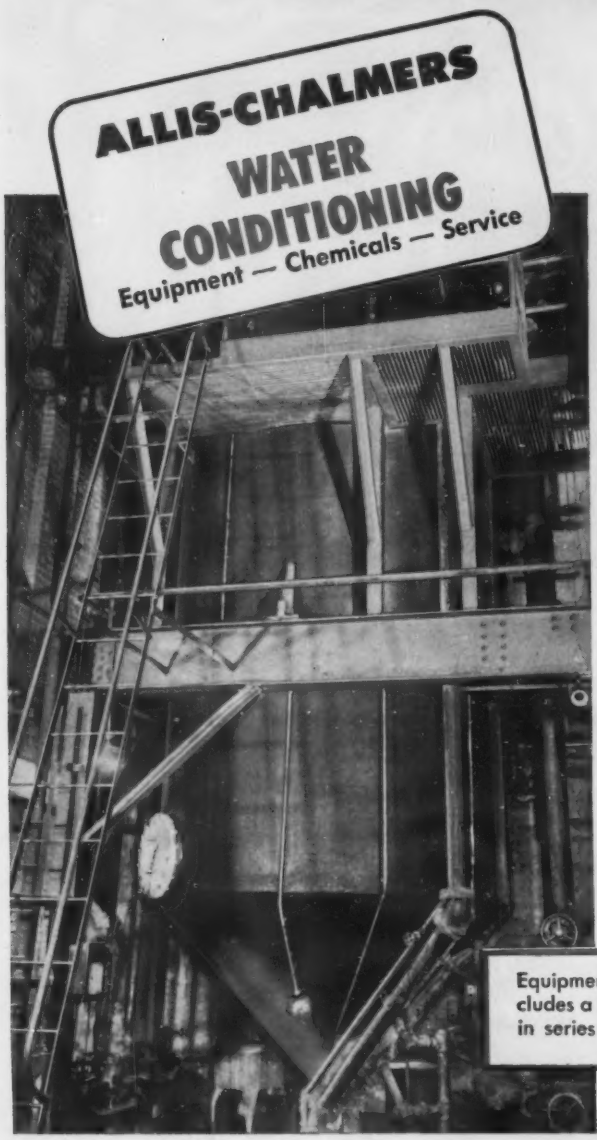
MAKERS OF 'AMERICAN' INDUSTRIAL INSTRUMENTS, 'HANCOCK' VALVES, 'ASHCROFT' GAUGES, 'CONSOLIDATED' SAFETY AND RELIEF VALVES. BUILDERS OF "SHAW-BOX" CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES.

Minneapolis Gas Co., Minneapolis, Minn., Gets...

MORE BOILER FEEDWATER



How to increase feedwater supply without adding excessively to chemical and equipment costs? That was the problem at Minneapolis Gas Company, Minneapolis, Minn., when installation of new equipment increased demands on the power plant.

Allis-Chalmers water conditioning engineers solved this problem with a hot lime, ion exchange system that provides zero hardness, extremely low silica content, low alkalinity and low CO_2 in steam. Chemical costs are very reasonable, since only salt and lime are needed. An added dividend can come from the small amount of space required for equipment — for example, in one installation of this type, the resin tanks are tucked under the basement stairs.

Solve Any Water Problem

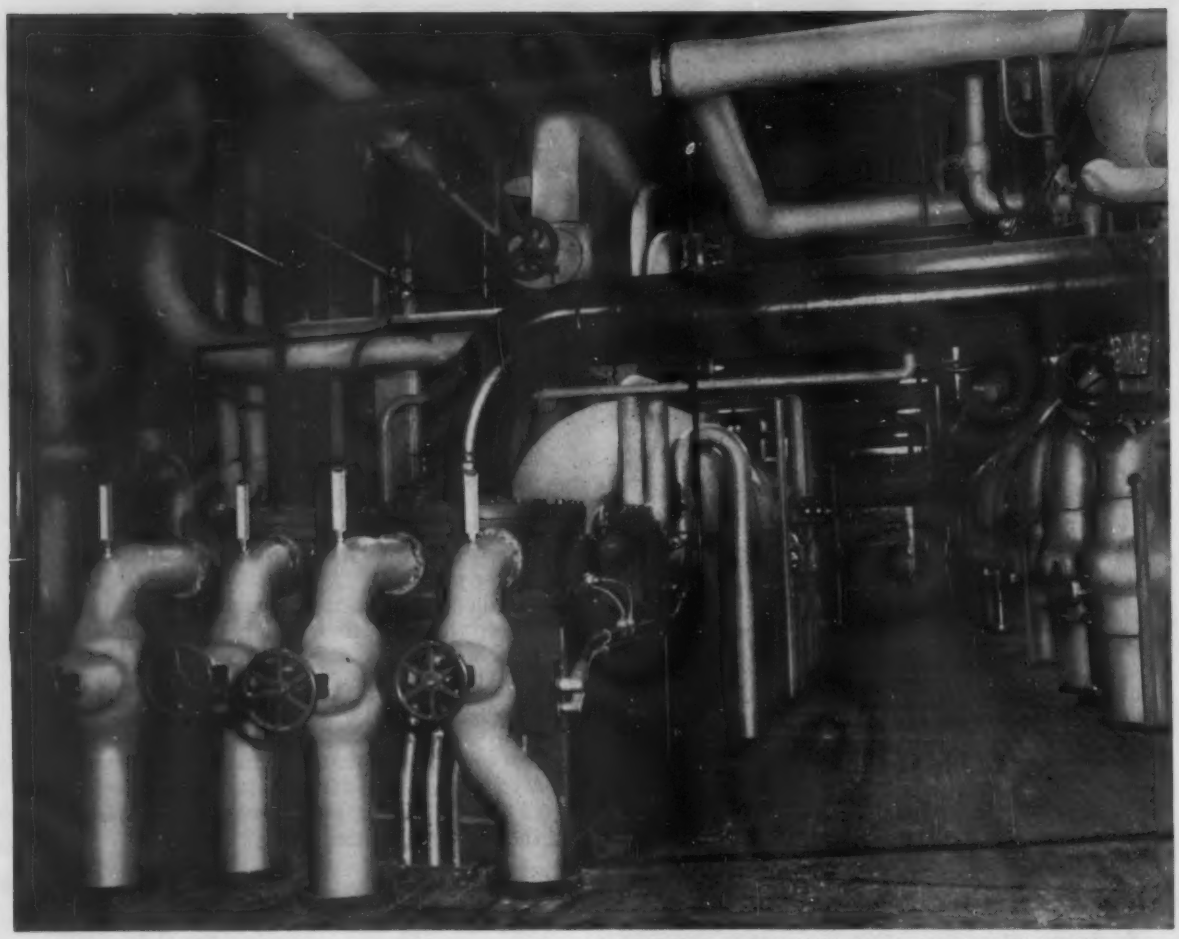
You can find a solution to any water conditioning problem by consulting with an Allis-Chalmers water conditioning expert. Allis-Chalmers will provide analysis and a complete recommendation, in addition to supplying you with the chemicals and equipment you need.

If you would like to learn more about the hot lime, ion exchange process outlined above, get a copy of Allis-Chalmers Water Conditioning Informational Bulletin 49 from your nearby A-C district office, or write Allis-Chalmers, Milwaukee 1, Wisconsin.

A-4403

Equipment similar to this at Minneapolis Gas Co. includes a hot process lime-soda softener which is placed in series with the hot zeolite (ion exchange) unit.

ALLIS-CHALMERS



Main steam line and feeder equipment of a large southern power station insulated with a combination of K&M Hy-Temp and "Featherweight" 85% Magnesia.

Dollar and heat loss minimized by power stations with

K&M HIGH TEMPERATURE INSULATIONS

For efficient, money-saving conservation of heat, keep in mind dependable K&M High Temperature Insulations. For example, by itself, "Featherweight" 85% Magnesia (85% basic carbonate of magnesia and asbestos fiber) effectively insulates piping and equipment with temperatures up to 600° F. Used with a primary layer of K&M Hy-Temp Insulation (diatomaceous silica), the combination is effective on applications up to 1900° F.

These K&M insulations last the life of the equipment they serve. They withstand moisture, vibration and frequent temperature changes.

New and now available is "Featherweight" Water-Resistant Magnesia Insulation for temperatures up to 450° F. It is for use where severe water exposure may damage the insulation or on indoor lines and equipment where high humidity and moisture is necessary.

Your K&M distributor is an experienced applicator who will gladly give you more information on these heat-saving, money-saving K&M insulations. Or write directly to us.

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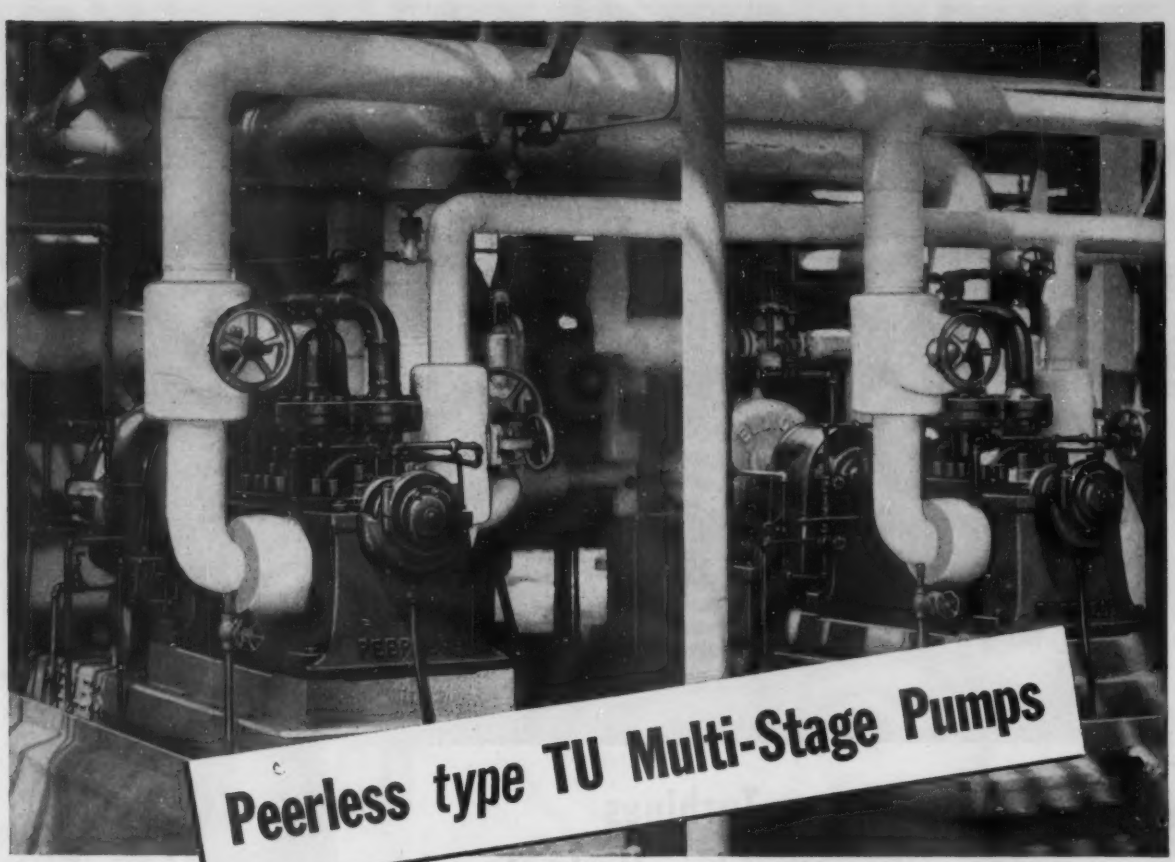

Peerless type TU Multi-Stage Pumps

PEERLESS PUMPS

GENERAL SPECIFICATIONS

HEADS	Up to 1600 Feet
CAPACITIES	Up to 3000 GPM
TEMPERATURES	Up to 300°F
CASE PRESSURES	Up to 800 Lbs.
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PEERLESS PUMP DIVISION
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4 COST-SAVING FEATURES OF THE TYPE TU LINE

- *SIMPLICITY IN DESIGN*
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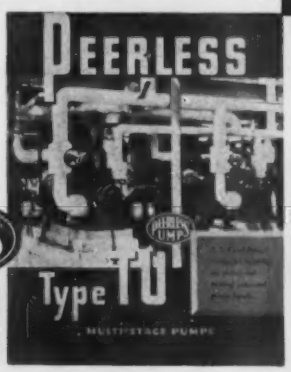
- *DURABLE, RUGGED CONSTRUCTION*
- *ON-THE-JOB DEPENDABILITY*



2, 3, 4 AND 5-STAGE PUMPS FOR SUPPLYING CIRCULATING AND BOOSTING WATER AND PROCESS LIQUIDS AGAINST MEDIUM AND HIGH HEADS. Put these dependable pumps to work for you. They'll deliver high maintained efficiencies over an extended service life. Their split-case design makes them easy to service and maintain. Their precision construction guarantees year after year durability. In all sizes 4" and under, cross over between stages is built integral with upper pump case. Over-size shafts, wear rings, shaft sleeves, heavy duty ball bearings, modern case and impeller design are outstanding features. Choose from many types and sizes for all head and capacity requirements.

PROFUSELY ILLUSTRATED BULLETIN. A new 4-color bulletin describes the Peerless Type TU pumps. It's complete with pump cross-section, dimensional drawings and load-capacity data. Use coupon below.

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301 West Avenue 26, Los Angeles 31, California

Please send a copy of TU Pump Bulletin No. B-1400 to:

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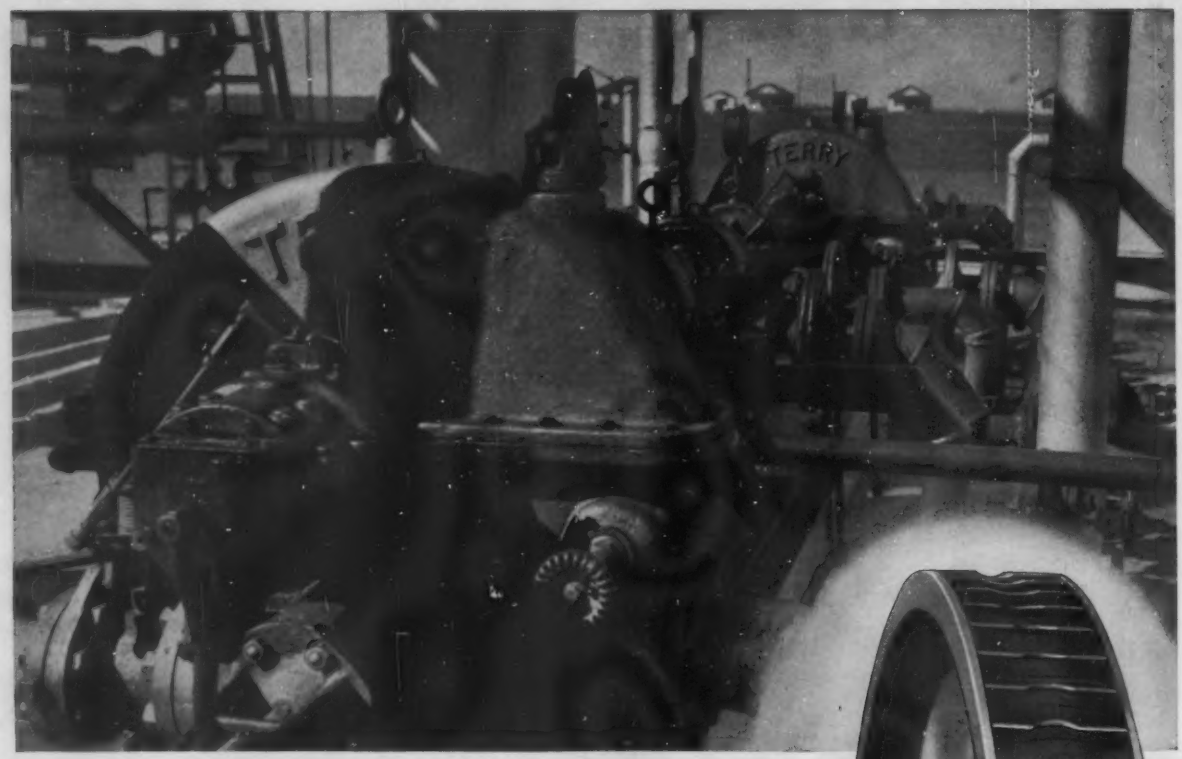
POWER



Two Terry Turbines equipped with "trouble eliminators"

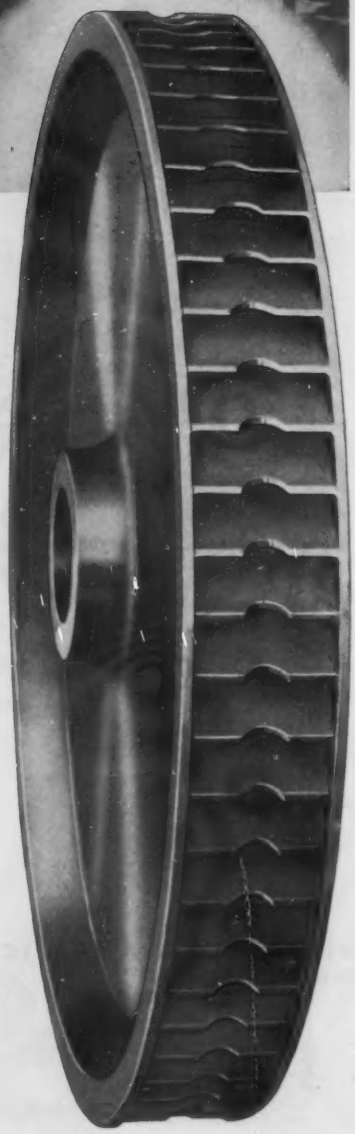
Because these turbines have solid wheels, they can take a lot of abuse, without complaint. Here's why:

1. The wheel has no separate parts to become loose or work out. It is a single forging, in which a series of semi-circular buckets is milled.

2. Blade wear is of little consequence because the power-producing action of the steam takes place on the curved surfaces at the back of the buckets. Wear does not materially affect horsepower or efficiency.

3. The blades cannot foul. There is a one inch clearance on either side of the wheel and, in addition, the blades are double rim protected. There is no need for close axial blade clearance, because the steam enters the buckets in a direction at right angles to the shaft.

For complete details of these *work horses of industry*, send for a copy of bulletin S-116. No cost or obligation.



THE TERRY STEAM TURBINE CO.

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You Get Time-Tested Dependability With

NAVCO Counterpoise*

Pipe Hangers

The constant load-carrying capacity of Navco Counterpoise* Pipe Hangers has been proven during an extended period of satisfactory service as the first accurate and efficient support for high temperature piping systems. They are being used extensively in steam generating stations, refineries and chemical plants.

The Counterpoise Hanger is a spring-actuated counterbalance. An ingenious system of linkage transforms the varying force of the spring in an accurate mathematical ratio to produce a load supporting effort of constant value throughout the entire range of expansion travel.

The design permits great flexibility of installation and saves valuable space in congested areas. All parts are ruggedly made and have a high safety factor, yet excess weight and oversize physical dimensions have been avoided to hold space and structural load requirements to a minimum.

The Navco Counterpoise Hanger is available in 16 different frame sizes with load capacities ranging from 200 to 16,000 pounds and expansion travels up to 12 inches. For detailed information on how you can get dependable support with this unique hanger, write today for our 12-page illustrated bulletin #153.

Note above how the flexible top connection permits the hanger assembly to fall in line with the direction of the load pull, so that horizontal travel of the piping has no appreciable effect on the hanger operation. The unit may be positioned at any angle. This affords flexibility in installations where close clearances are a factor.

** Counterpoise is a trade name of the National Valve & Manufacturing Company*

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Handsome is...

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AND the Taylor 6″ Dial Indicator does a handsome job indeed of giving you accurate readings at a glance of either temperature, pressure or load. Its unique stainless steel movement is actuated by a new powerful Bourdon spring to give more accurate performance throughout the range span.

Available with electric alarm mechanism having high and low contacts easily adjusted to give accurate, dependable notice when danger points are reached . . . Zero settings are easy with the lightweight aluminum MICRO-JUST pointer. The fume and moisture proof case may be face or flush mounted, panel or field.

For Temperature Applications there are four types of actuation: Mercury, gas, Monolex* organic liquid or vapor. Ranges from minus 125 to +1200°F.

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Ask your Taylor Field Engineer about this very versatile 6″ Dial,—and about controllers, recorders, transmitters, and industrial thermometers of special interest to the power industry. Or we'll be happy to send you the pertinent catalogs or bulletins. (For the 6″ Dial it's **Bulletin 98214.**) Taylor Instrument Companies, Rochester, N. Y. or Toronto, Canada.

Instruments for indicating, recording and controlling temperature, pressure, flow, liquid level, speed, density, load and humidity.

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Taylor Instruments
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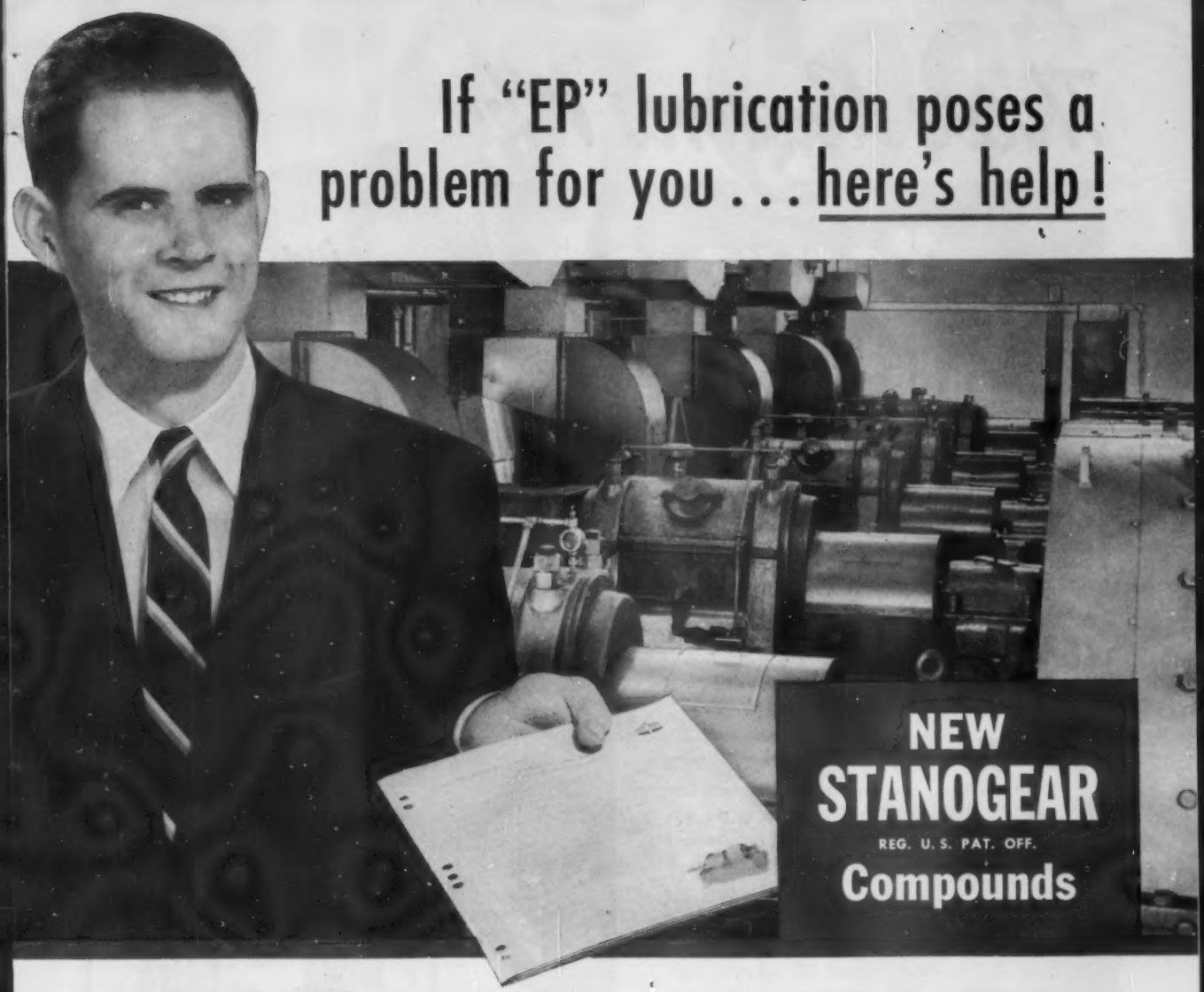
IN HOME AND INDUSTRY

If "EP" lubrication poses a problem for you . . . here's help!



Here's new technical letter on Stanogear Compounds—send for free copy today!

If you've been having lubricating problems with overloaded or shock-loaded gears on your equipment, New STANOGEAR Compounds—with 7 better EP lubricating features—are made just for you. New and improved STANOGEAR Compounds are recommended for industrial gear applications where the operating conditions of the gear unit demand an extreme pressure lubricant . . . their superiority has been proved in test after test and *on the job!*

New STANOGEAR Compounds work seven ways better to solve your EP problems: **1.** higher load-carrying capacity **2.** superior retention of load-carrying capacity **3.** freedom from objectionable deposits **4.** excellent storage stability **5.** good water separation **6.** anti-foaming **7.** increased versatility

Now Standard Oil has prepared a special technical letter to give the complete story on STANOGEAR Compounds and EP lubrication. For your copy of this factual, informative bulletin, call your nearest Standard Oil office. The Standard Oil lubrication specialist there can answer your questions and send you a copy of the EP story, without obligation. Or write to: Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois.

STANDARD OIL COMPANY

STANDARD *(Indiana)*

Three Reasons Why

...Years of Trouble-Free Service

Cutaway view of DZ-608 breaker, showing one *Ruptor* unit, with bayonet-type movable contact in open position.

Ruptor unit in contact break position.

Ruptor unit in full closed position.

One **Few moving parts!**

Bayonet contacts (1) are the only moving parts of the *Ruptor* interrupting device.

Two **Easy inspection!**

Drop the tank, and the bayonet contacts are visible in open position. For access to the stationary contacts, one needs only to remove four bolts and cylindrical shell (2).

Three **Self-aligning and Self-cleaning contacts!**

Tulip and bayonet contacts (3) maintain high conductivity without readjustment or cleaning. Arc energy is minimized by efficient interruption within oil-filled *Ruptor* unit. This in turn contributes to long contact life and low oil deterioration.

In addition, a mechanically trip-free solenoid operating mechanism controls contacts of time-proved *Ruptor* interrupting devices And pole unit mechanism is self-lubricated — completely enclosed — sealed from dust, dirt, corrosion.

In brief, Allis-Chalmers DZ breakers are built to assure years of dependable, trouble-free service.

Allis-Chalmers power circuit breakers are available in ratings from 2.5 to 230 kv, with interrupting capacities from 15,000 to 10,000,000 kva, to meet all industrial and power company requirements. For more information, call your nearby A-C representative, or write to Allis-Chalmers, Milwaukee 1, Wisconsin.

A-4057

Ruptor is an Allis-Chalmers trademark.

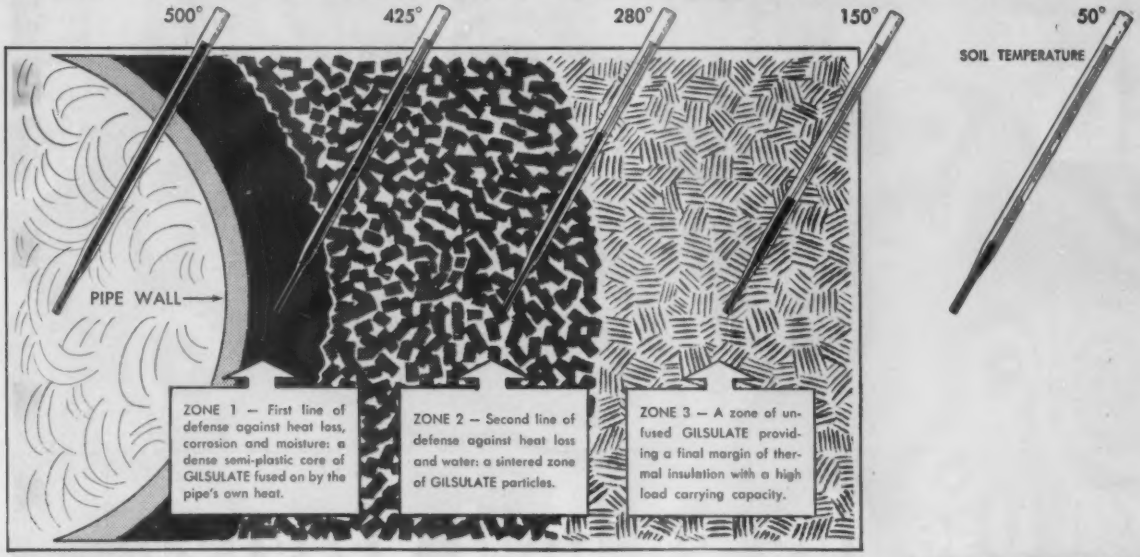
TYPE	RATED KV	MINIMUM KV AT RATED KVA	RATED AMPS	KVA INT. CAPACITY
DZ-40B*	7.2	2.3	600	100,000
			1200	100,000
			2000	100,000
DZ-60B†	13.8	4.0	600	150,000
			1200	150,000
DZ-100B†	13.8	4.0	1200	250,000
DZ-200B†	13.8	6.6	1200	500,000
			2000	500,000

*Ask for Bulletin 71B6179. †Ask for Bulletin 71B6129.

ALLIS-CHALMERS

Lowest Cost

PER INSTALLED LINEAR FOOT OF ANY HOT UNDERGROUND PIPE INSULATION


500°
425°
280°
150°
50°
SOIL TEMPERATURE
PIPE WALL
ZONE 1 — First line of defense against heat loss, corrosion and moisture: a dense semi-plastic core of GILSULATE fused on by the pipe's own heat.
ZONE 2 — Second line of defense against heat loss and water: a sintered zone of GILSULATE particles.
ZONE 3 — A zone of unfused GILSULATE providing a final margin of thermal insulation with a high load carrying capacity.

GILSULATE®... the triple-zone insulation that fuses itself into lifetime protection for hot underground pipes. Water-proof, corrosion-proof, root-proof, acid/alkali-proof.

Compare your present insulation methods with Gilsulation:

1. Pour Gilsulate granules out of the bag onto the pipe; tamp it down.
2. Backfill: *the job is insulated!*

Gilsulate—nature's own insulation—is a unique, solidified hydrocarbon that virtually installs itself. Normal pipe-heat (up to 520°F) does the rest—fuses the Gilsulate to the pipe in hours, forming a massive circular solidified sheath.

Gilsulate costs less installed per linear foot *than any other underground pipe insulation*... it's easiest to use... and has been tested in scores of the country's largest and most important installations.

Some additional Gilsulate advantages:

- *3 grades available*—220° to 520° F
- *needs no sleeves* or mechanical sheaths
- *requires no mixing* or special handling
- *can't be punctured* — leave rocks in backfill
- *pipe expands and contracts* within Gilsulate structure
- *proved in actual use* in hundreds of new construction and replacement installations

Send coupon for descriptive literature.

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Affiliate of Barber Oil Corp. & Standard Oil Co. of California

No skills necessary—simply pour Gilsulate out of 100 pound bags, tamp and backfill. Can be used under any and all conditions—no matter how many pipes, whatever the space.

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THE TRIPLE-ZONE INSULATION
FOR LIFETIME PROTECTION
OF HOT UNDERGROUND PIPES.

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or 1145 East Jersey Street, Elizabeth 4, N. J.

Please send me descriptive literature on Gilsulate.

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COMPANY.....

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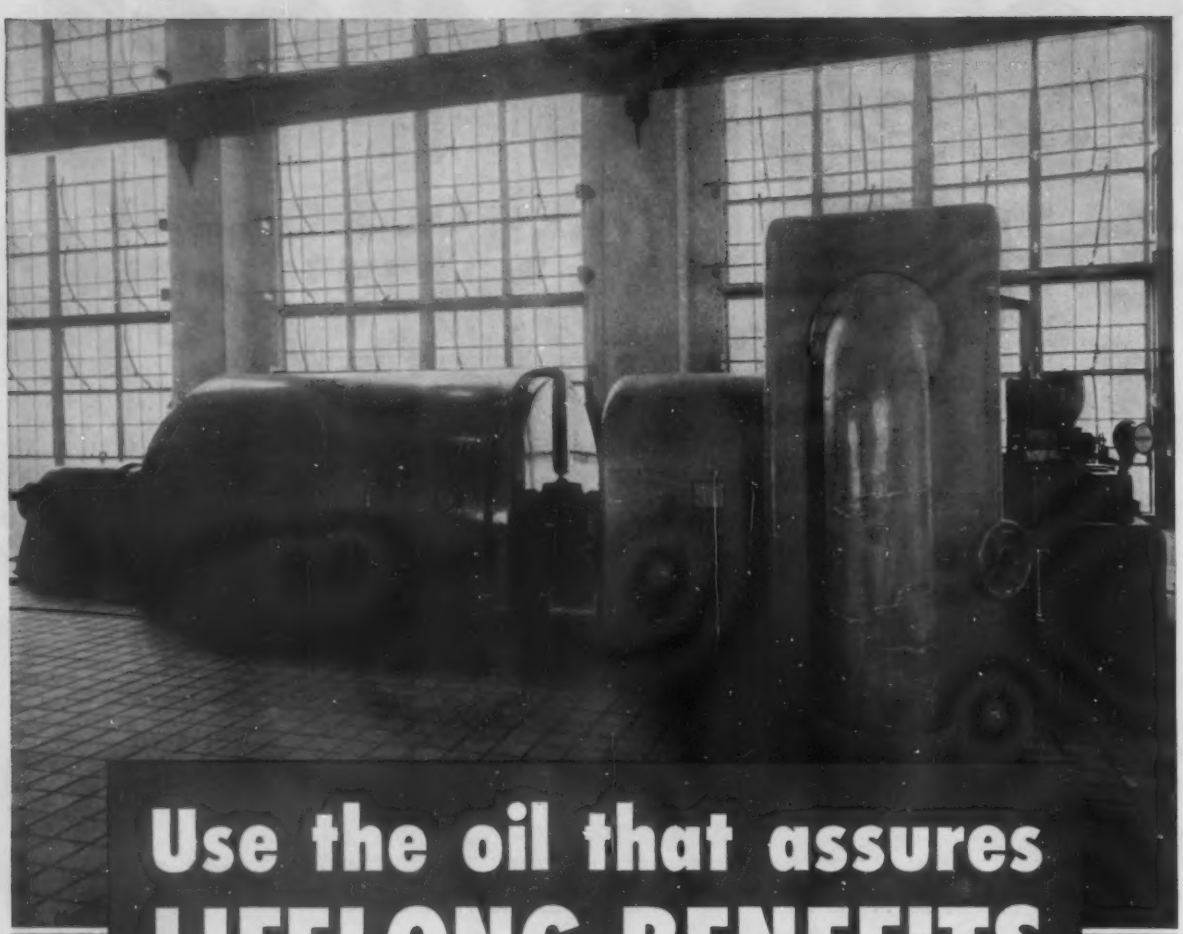

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FOR ALL TURBINES

A New Editor for POWER

WITH this issue, Philip W Swain attains his retirement and concludes 20 years of active service as Editor of POWER. And with this issue, that chief responsibility is placed in the experienced hands of a new Editor, Louis N Rowley.

Because the editorial leadership of your magazine is of vital concern to all readers, I welcome this opportunity to tell you something about these two men. You will find biographical stories of both on pages 4 and 5, but here, on this page, I mean to talk of them in terms of the useful mission of POWER, as we see it, and of the service it renders to American industry.

In POWER's 72 years, a number of editors have headed its staff for short periods, but only two—Fred Low and Phil Swain—had tenures long enough to make indelible imprints. Low was Editor from 1888 to 1930; Swain from 1934 to now. Thus Low carried the full responsibility for 42 years and Swain for 20, a total of 62 of the 72 years of POWER's life. This fact is truly significant.

It is equally significant that Low continued to head POWER for a full nine years after he brought Swain to its staff as Assistant Editor in 1921. This means that POWER's leadership stands now no more than once removed from experience and inspiration dating back to 1888. And when you consider that Lou Rowley has, in turn, worked with Phil Swain for 17 years, you see fully the continuity of leadership POWER has enjoyed.

So it is entirely natural that both Swain and Rowley have the same basic view of POWER as did its first great Editor: as a superlatively practical service to the engineers who design, operate and maintain power-service facilities throughout all U.S. industry.

During his tenure, Phil Swain has expanded POWER's editorial service as new developments in technology—from air conditioning to the atom—have widened the horizon of the field. The 20 years of his editorship have seen maximum steam pressures triple, the gas turbine come of age and energy from the atom become a reality. On all these broad engineering frontiers, and in the host of minor advances that add up to progress, Phil Swain and POWER have been pioneers.

That is why a happy part of this announcement is the fact that Phil Swain's total service of 33 years to POWER is not terminated. He is now going to assume the new duties of Consulting Editor.

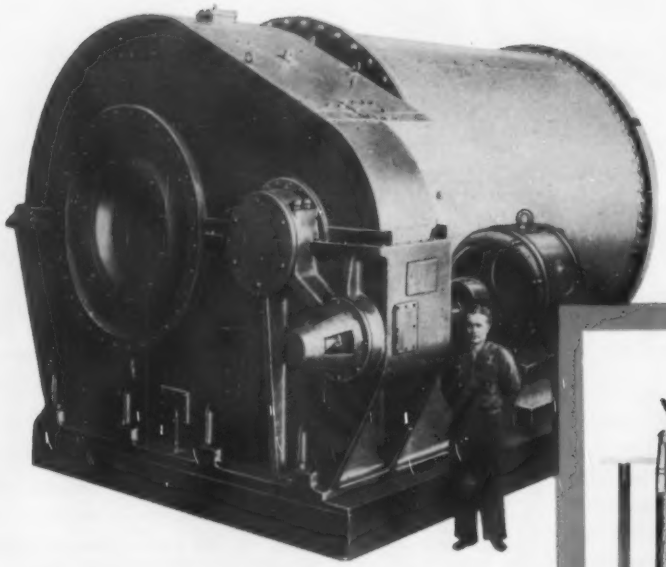
By education, experience and personal qualities, POWER's new Editor is admirably fitted for his broader responsibilities. Lou Rowley holds degrees in engineering and business administration. He has a firm grasp of practical power engineering, particularly in the fields of steam, internal-combustion engines and gas turbines. He has mastered the newest journalistic techniques. As an individual he is both a teamworker and a keenly logical and original thinker.

So the staff now has a new, capable, aggressive leader who is completely familiar with the job to be done and the best ways of doing it. Lou Rowley has been Executive Editor since January of 1949. His appointment as Editor is the best evidence a publisher could give of that guarantee all readers should expect:

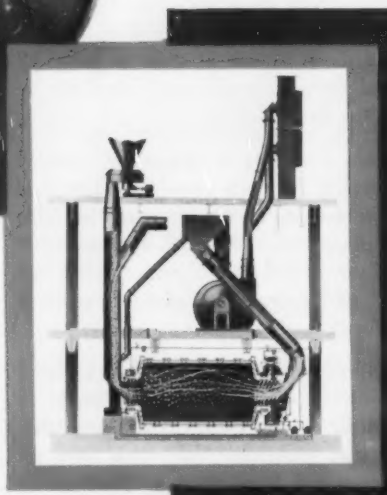
The passing years find POWER *always ready to maintain the quality of its leadership.* POWER *will move on without pause to new decades of still greater service to engineers everywhere.*

Shelton Fisher, *Publisher*

IF YOU PLANT ... CONSIDER



* THE KENNEDY SAVES UP TO



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IT COSTS LESS ... TO OWN THE BEST!

Whether you are modernizing your present plant or building a new one, it will *pay you* to consult a KVS engineer. He will show you operating data and give you *facts* about plants that are saving as much as $3.00 per ton on coal costs with KVS Pulverized Coal Firing Systems. These tremendous savings are effected through the use of low grade, low cost coal, pulverized to superfineness with instant response to combustion controls. The KVS Pulverized Coal Firing System provides maximum heat from every ton of coal. Consult KVS for "facts that count" in economical steam plant operation.

OPERATE A STEAM THESE COST SAVING* FACTS!

PULVERIZED COAL FIRING SYSTEM $3.00 PER TON ON COAL COSTS...

FACTS ABOUT COAL

Industry is counting more and more on coal. Modern combustion methods, more efficient handling equipment and greatly improved pulverization methods show coal cost savings that more than offset the investment in a modern firing system.

Coal is safest to store and use. Production is the most efficient in the world. Resources are adequate to meet all demands. Prices remain most stable of any fuel. Produces more steam at lower cost.

FACTS ABOUT KVS PULVERIZED COAL FIRING SYSTEMS

Burns any grade of coal—cheapest as well as most costly. Delivers *maximum* heat from every ton. Coal completely carbureted . . . ready for combustion. Low operating and maintenance cost. Fully air swept . . . big trunions for air sweeping. 85% to 90% through 200 mesh . . . 20% moisture liberated while pulverized. Tramp iron actually aids pulverizing. Balls added without shutting down. Unburnt carbon losses, less than ½%.

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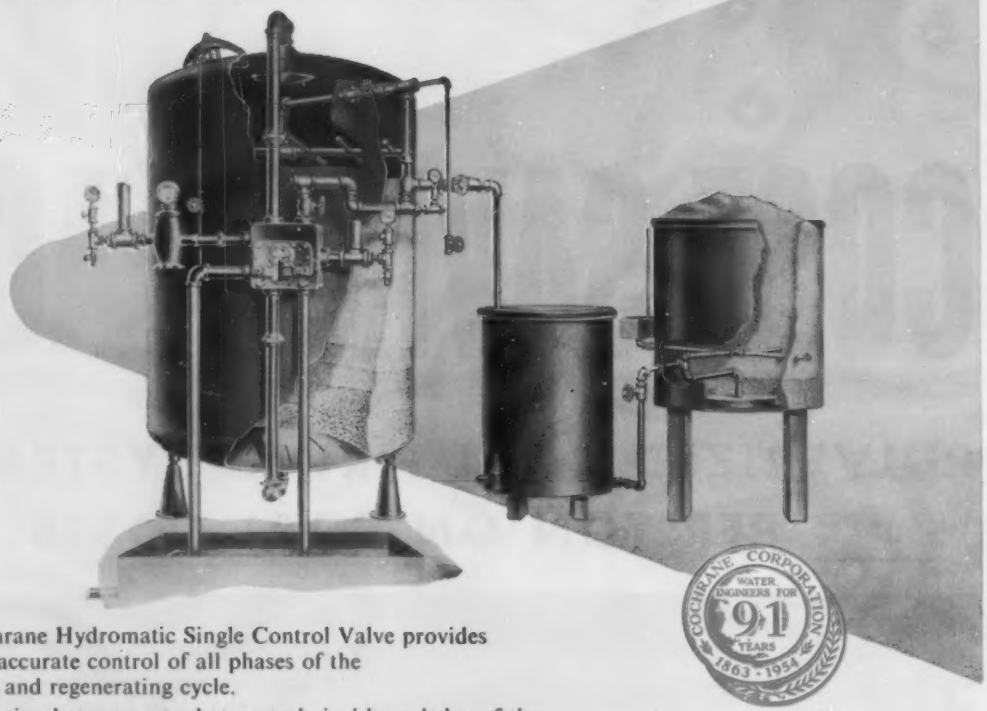
Cochrane ZEOLITE SOFTENERS

provide easy, economical operation



The Cochrane Hydromatic Single Control Valve provides positive, accurate control of all phases of the softening and regenerating cycle.

It is so simple to operate that no technical knowledge of the softening process or the equipment is required. High quality effluent is thus assured at a minimum cost and maximum delivery.

Cochrane's 91 years of water conditioning leadership and its complete line of equipment assures you unbiased recommendations for equipment to performance requirements. For the right answer to your water problem, call a Cochrane Engineer today.

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Please send me a copy of your Publication 4520-A on your Zeolite Softeners with the Cochrane Hydromatic Single Control Valve.

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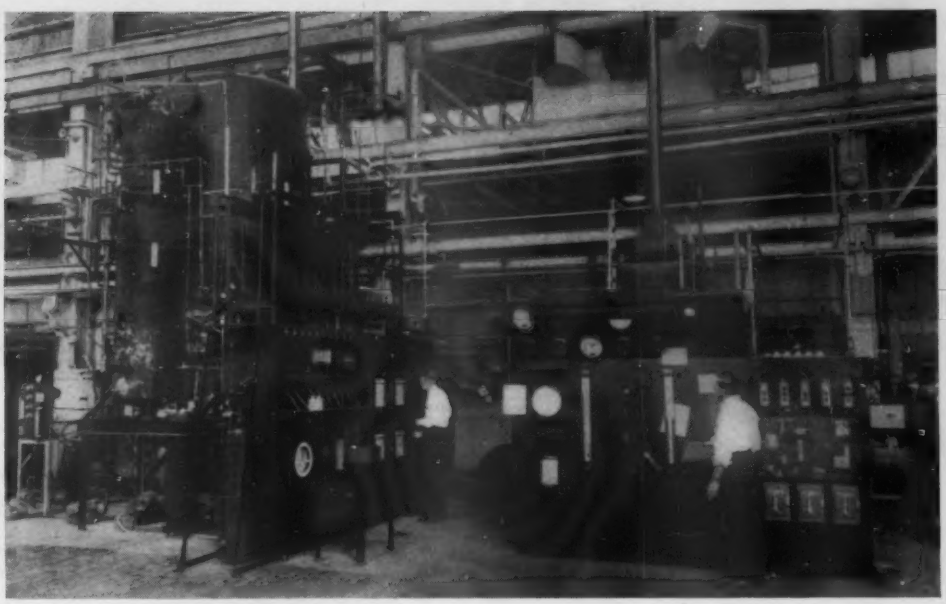
Power
SEPTEMBER 1954



Pilot test unit for supercritical pressure, B&W Alliance, Ohio, Research Center, laid groundwork for new high-efficiency plant design

Developing the first commercial supercritical steam generator

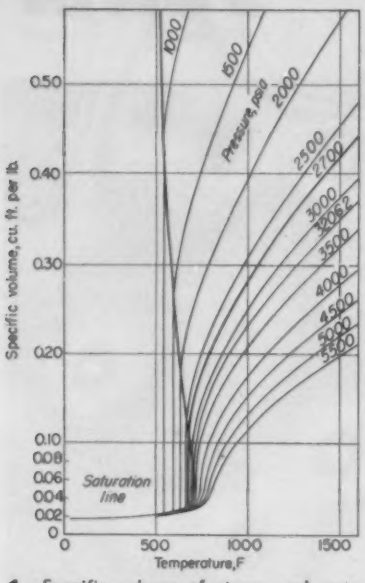
By W H ROWAND, *Vice-President, The Babcock & Wilcox Company*

• America's electric utilities have hammered down the price of power by 30% during the past 25 years, while cost of living has almost doubled during the same period

• Now, to continue this progress, we seek further efficiency gains through still higher temperatures and pressures above the critical. And for the 5000-psi 1150-F double-reheat conditions chosen we turn to the once-through type of steam generator. Why? (pp 78-80)

• Natural circulation boilers have chalked up a successful record of generating steam at pressures as high as 2700 psi (pp 76-77). But the shrinking difference between density of steam and water makes this the practical upper limit of pressure for this type

• So the once-through design, used in the past for special jobs (pp 74-75), now comes into its own with advent of superpressures



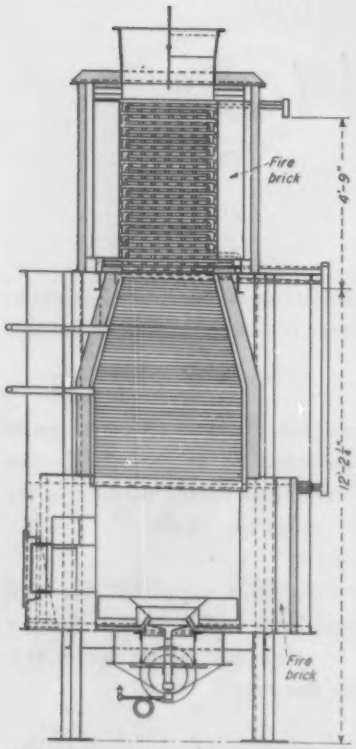
1 Specific volume of steam and water changes with pressure, temperature

Pressures near critical raise steam-water separation problem

Several steam generators operate today with a drum design pressure of 2400 psi and steam temperature of 1050 F, with reheat to 1050 F. The LaMont-type forced-circulation units, at Kearny Station of Public Service Electric and Gas Co, have been running for about a year supplying steam to the turbine at 2350 psi, 1100/1050 F. A natural-circulation unit is now being built for this utility's Burlington Station. It is designed for 2700 psi and will deliver steam at 2350 psi, 1100/1050 F.

A design pressure of 2700 psi is about the limit for either natural-circulation or forced-circulation boilers of the Steamotive or LaMont type. Both depend on the circulation of an excess amount of water and separation of steam and water in some kind of drum. The difference in steam and water densities makes separation possible. As pressure increases, however, this difference becomes progressively smaller. At critical pressure and temperature, steam and water weigh the same, about 20 lb per cu ft. They can, therefore, no longer be separated and a "once-through" type of steam generator must be used. Fig. 1 shows the change in specific volume for water and steam at various pressures and temperatures. A marked change in the specific volume of both steam and water can be seen between a pressure of 2700 psi and the critical pressure of 3206 psi.

Tried out long before need for supercritical pressures



4 Once-through steam generator was run up to 5000 psi experimentally, 1929

► THE ELECTRIC UTILITIES and the manufacturers who supply their equipment are never satisfied with the technical progress made in the past. Constant, intensive research aims at improving design, operation and service life of equipment, with ever higher plant efficiencies as the ultimate goal.

Higher pressures and temperatures remain the major way to raise power-generation efficiency. Generally speaking, advances in pressure and temperature go hand in hand. There would be little gain in making a big jump in pressure without a corresponding jump in temperature.

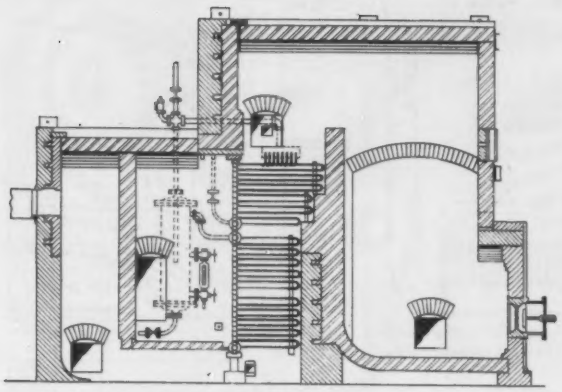
In this drive for progress the power industry has moved forward as fast as metallurgists have made satisfactory materials available. And the designers have explored ways around pressure limitations, such as those inherent in the decreasing differential between steam and water density (see above).

Once-through boilers. "Flash" boilers, in which no steam-water separation is involved, have a long history. In these units water flows through one or more tubes, receiving heat, and comes out as superheated steam. Hundreds of patents have been taken out on different arrangements, beginning as early as 1824 with Buchanan and Paul, continuing with Belleville in 1850, Maxim in 1897, White, and Clarkson and Capel in 1900, and several others up to the present. Many patents were for the propulsion of vehicles. Those around 1900, in particular, were connected with the advent of automobiles.

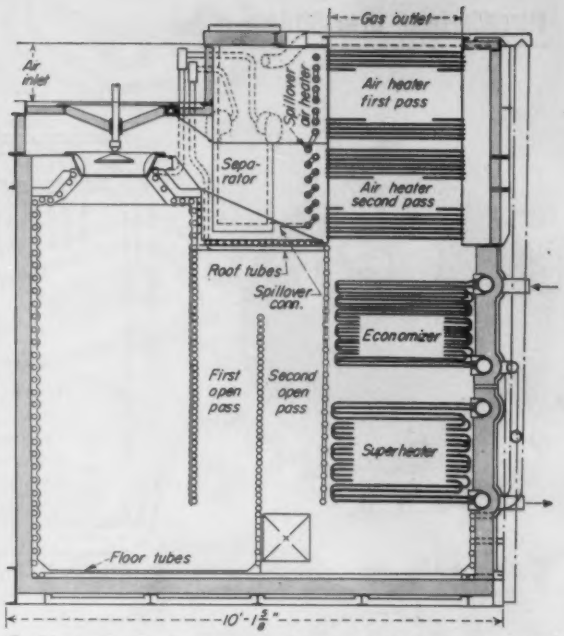
Flash boilers have many desirable features, such as elimination of drums, freedom in shape and routing of tubes, wide range of steam temperature made possible by the lack of demarcation between the evaporating and the superheating sections.

The B&W Co built and tested extensively a once-through type steam generator for 600 psi at its Bayonne Laboratory in 1916, Fig. 2. This work, led by Dr D S Jacobus and H J Kerr, resulted in building several 2-stage boiler designs using economizers of the steaming type.

In the early 1920s, Mark Benson of Czechoslovakia originated the idea of running a once-through steam generator at the critical pressure (thereby eliminating the evaporation zone), expanding the fluid to a lower pressure and then superheating it for use in a turbine. In 1923, together with English Electric Co, Ltd, he built a 9000-lb-per-hr experimental unit at Rugby, England. This unit ran for some time under these conditions. Shortly thereafter Benson joined forces with Siemens-Schuckertwerke of Germany. Since then this organization has been the motivating force in the development of the Benson type of once-through steam generator.



2 Oil-fired drumless once-through steam generator was run at 600 psi back in 1916 by B&W for research and development



3 Vertically fired open-pass Steamotive boiler uses forced circulation, installed where space, weight are restricted

arose, once-through boilers met various special needs, but...

In 1931, a 250,000-lb-per-hr Benson boiler was built at Langerbrugge, Belgium. This unit ran experimentally at critical pressure. The operating pressure, however, was soon reduced to subcritical because of frequent tube failures. This resulted from inadequate water treatment prevalent at that time and not understanding the metallurgical factors involved in the manufacture of satisfactory tubing. This type boiler ran satisfactorily at subcritical pressures, provided proper care was taken in water treatment. Since then many Benson boilers have been built and are running in Europe at pressures between 1200 and 2200 psi at superheater outlet. Four units just being completed are designed to run at 2675 psi at superheater outlet.

During the late 1920s, B&W built an experimental once-through unit and ran it at pressures up to 5000 psi with temperatures of 900 to 950 F. Results of this work were reported to the ASME in 1931 by the late H J Kerr in a paper, "Once-Through Series Boiler for 1500 to 5000 Lb Pressure."

At about the same time B&W also built a similar unit for Purdue University, Fig. 4. This unit ran more than 10,000 hr for experimental work at pressures to above 5000 psi. Results were reported to ASME by A A Potter, H L Solberg, G A Hawkins in a 1931 technical paper, "Characteristics of a High-Pressure Series Steam Generator."

Because of limitations of water treatment and metallurgical techniques 25 years ago it was concluded at that time that commercial pressures of about 2000 psi were about as high as were economically practical. Also, because it permitted greater freedom in water treatment and in quality of boiler water, B&W decided to utilize the Steamotive-type forced-circulation boiler. The unit circulates 10 to 30% water in excess of the steam quantity generated. A separating device removed the boiler-water salts with the separated water. This cycle, while basically different from the LaMont cycle, in that it circulates very little excess water, also needs a recirculating pump or pumps. A small drum and water level help separate steam and water. The unit has a fixed amount of surface for superheating the steam. This development, carried out in the early 1930s, was reported to the ASME by E G Bailey, A R Smith and P S Dickey.

Since then B&W has built about 15 such units for naval, locomotive and other special purposes where space and weight were at great premium and where liquid or gaseous fuels permitted using a small combustion space, Fig. 3.

Natural circulation. After the lull in building activity during the depression, several central-station boilers were built in the late 1930s for 1500 psi with natural circulation. In 1936, with the development and use of large unheated external downcomers and cyclone steam separators in the drum, B&W definitely determined that natural circulation was more than satisfactory for pressures as high as 2700 psi. Fig. 5 shows the cyclone separators that essentially separate steam and water completely. This provides optimum circulating head for natural circulation in addition to producing pure steam.

Studies at that time indicated the advantages of these natural-circulation boilers, particularly where the type of fuel and ash characteristics determined size of the furnace. Natural-circulation boilers compared to the forced type provided more economical and reliable construction. The forced type required ferrules for distribution and recirculating pumps with seals handling relatively large quantities of very hot water at saturation temperatures.

The 2650-psi unit for the Twin Branch Plant of Indiana & Michigan Electric Co on the AG&E System, Fig. 10, was contracted for in 1937 and started in 1941. This pulverized-coal-fired unit delivers 550,000 lb per hr of steam to the 75-mw turbine throttle at 2300 psi and 940 F with one reheat to 910 F. This boiler was the forerunner of the many great high-pressure reheat units, operating on single-boiler-per-turbine principle, built since World War II.

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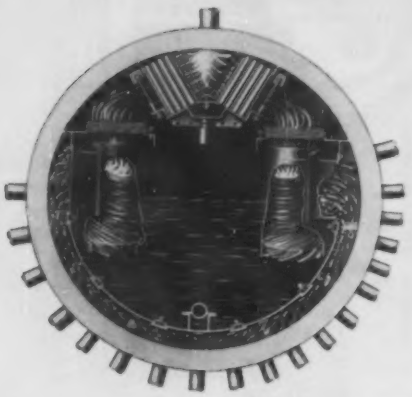
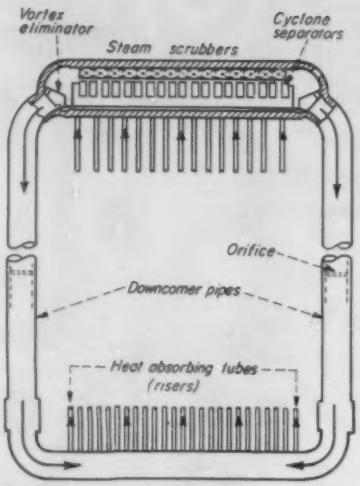
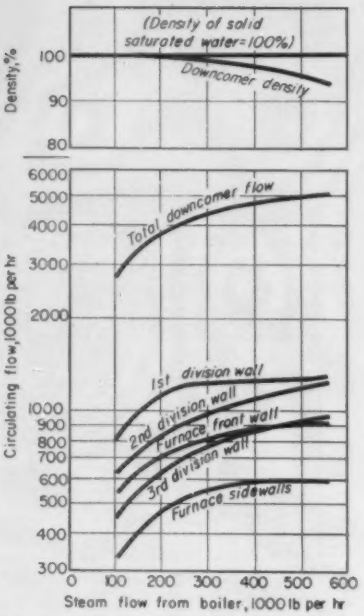


5 Low-pressure-drop cyclone separators assure solid water to the downcomers



6 Even at 2650 psi, orifices were needed to cut down excess circulating flow



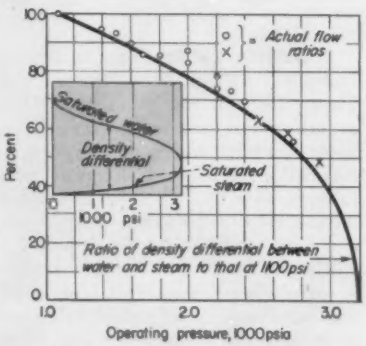
7 Downcomer-water density and flows remain satisfactory at all boiler loads

...natural circulation serves to 2700 psi

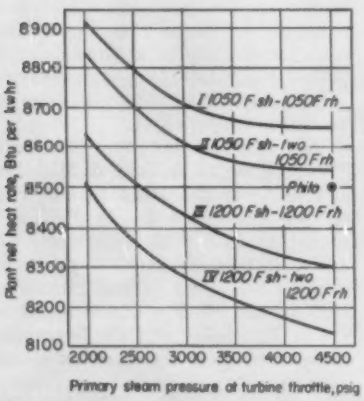
B&W had sufficient experience at that time with the outside downcomers and the cyclone separators to go ahead confidently with natural circulation for this high operating pressure. Fig 7 shows this confidence was later fully justified since the downcomer density and circulation were more than ample. Actually the original circulation was reduced 10% by installing 16½-in.-dia orifices in the two 28-in.-dia downcomer pipes, Fig. 6. This permitted operation with a wide range of water level by reducing the hydraulic gradient effect caused by endwise flow of the circulating water in the upper drum.

With the successful background of experience at Twin Branch (and also at Diamond Alkali with a 2200-psi 300,000-lb-per-hr unit placed in service in 1939) B&W has built or is building more than 100 large natural-circulation units for pressures from 1700 to 2700 psi. Forty-two of these units are in operation, some for several years.

Fig. 8 shows the effect of pressure on circulation. This is the result of tests carried out at Twin Branch, Diamond Alkali and at the Alliance Research Center of B&W. This shows that about 2700 to 2800 psi is the practical limit for either natural or forced circulation of the type depending on separation of steam and water. To go to higher pressures a once-through type of steam generator is needed.



8 Actual circulating flow-ratios closely follow the fluid density differential



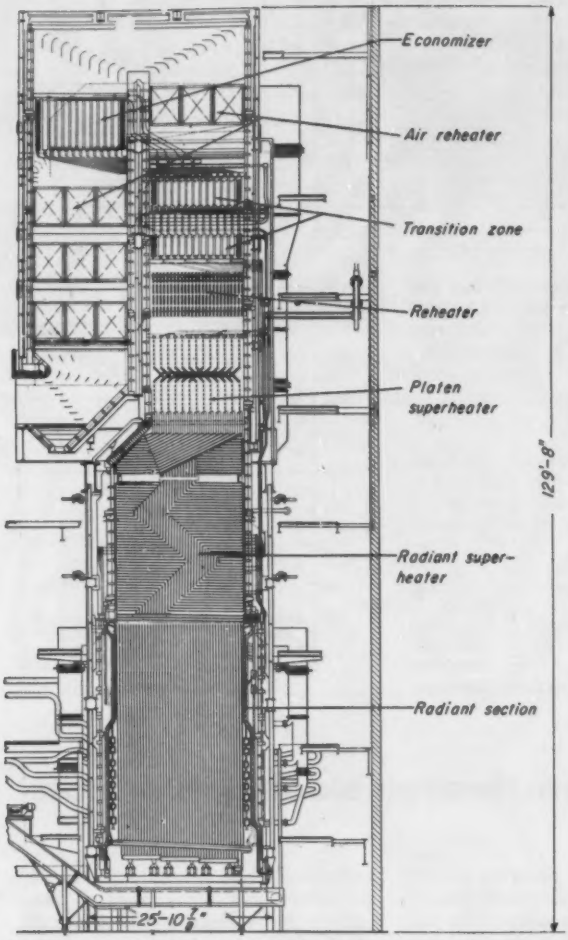
11 Boosting temperature and pressure together lower the station heat rate

Now, for next step forward with...

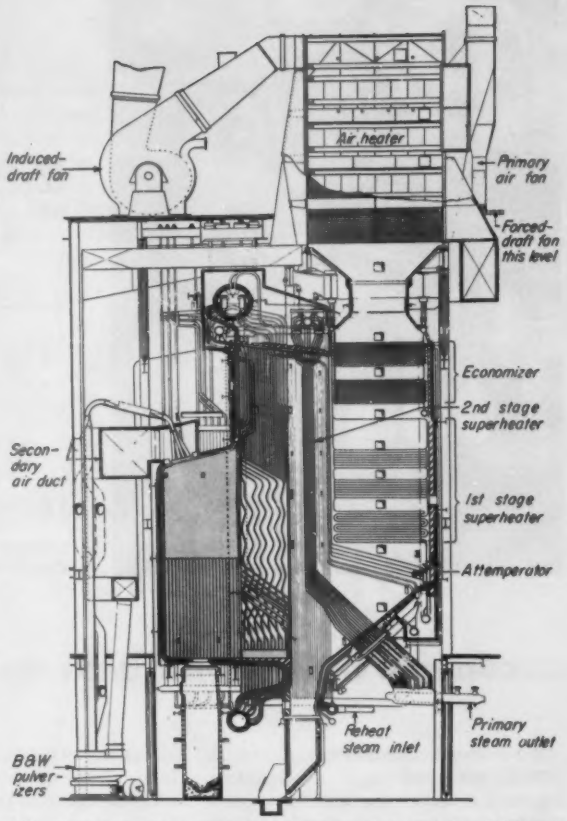
European once-through units. During the 1930s the Germans under Hitler built more than 50 Benson once-through drumless boilers. Heavy drum plate needed by natural-circulation boilers was being diverted to military uses. The Russians also built several once-through boilers during this same period. All of these units were for superheater outlet pressures in the range of 1200 to 2200 psi and for capacities up to 400,000 lb per hr. Indications are that these units operate satisfactorily, the main problems resulting from inadequate water treatment.

Since 1945, Siemens-Schuckertwerke and the boiler manufacturing licensees of Benson boilers, such as Durrwerke, have contracted for, and have built or are building about 50 units. These are for subcritical operation at pressures and sizes similar to those mentioned above. Great strides have been made in water treatment permitting successful operation of these boilers, Fig. 9.

U.S. need for superpressures. The



9 This typical Benson boiler for German stations runs at 275,000 lb per hr, 2050 psi, 950 F with reheat to 750 F



10 Twin Branch open-pass boiler was designed for 2650-psi 940-F steam at 550,000 lb per hr with reheat to 910 F

supercritical pressures and high temperatures, we need...

cycles in which the European once-through boilers operate are not as efficient as the cycles with natural-circulation boilers now being used in modern American utilities. To make a genuine advance in cycle efficiency it would not be sufficient merely to adopt the once-through or forced-circulation principle for operation at pressures already being widely used. A definite step upward in pressure and temperature would be necessary.

To appreciate how important an improvement in cycle efficiency is, note that the yearly fuel bill for any large central-station boiler today is usually greater than the original installed cost of the boiler equipment. Therefore any increase in cycle efficiency represents a worth-while amount of money.

In view of this, B&W decided about 1948 to step up its research on supercritical-pressure operation. Advances in metallurgy indicated that temperatures of 1100 F and higher would soon be feasible. Heat-rate studies were made for various cycle combinations. Fig. 11 shows the effect on the net over-all plant heat rate of increasing the pressure for various temperature levels with one and two stages of reheating. These curves show clearly why increases in pressure must have corresponding increases in temperature if improvement in efficiency is to be worth while. For example, at a temperature level of 1050 F very little gain results from increasing the pressure much above 3000 psi.

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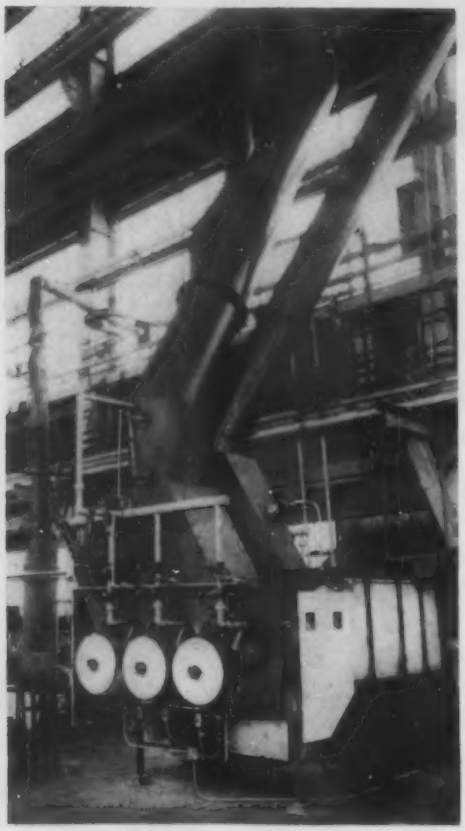
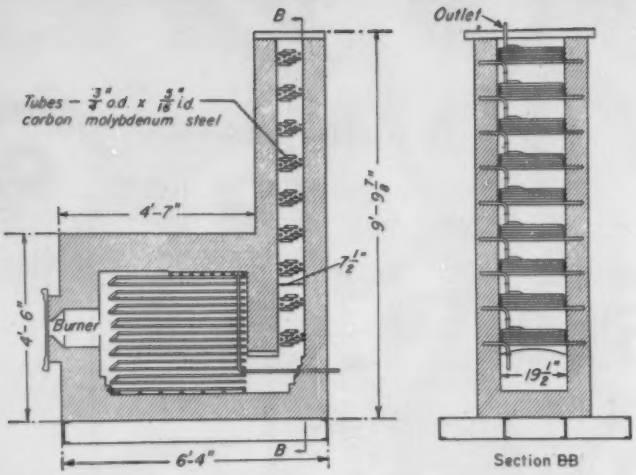
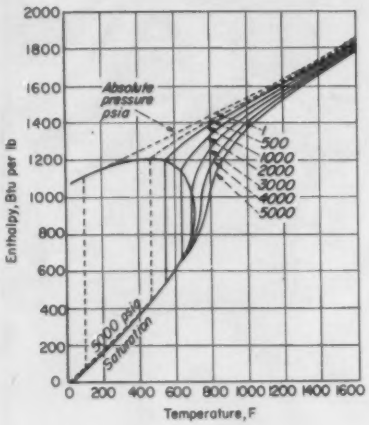




12 Supercritical test unit uses single tube with inlet at furnace wall running up to outlet at stack

13 One-sixth scale model of Philo cyclone furnaces helped to design the full-scale steam generator

14 Enthalpy of steam and water at constant pressure rises whenever the temperature increases



...commercially applicable once-through steam generators

When the temperature is raised to 1200 F, and particularly when adding a second stage of reheating, the pressure can be increased profitably to 5000 psi or higher. The over-all net heat rate of the best subcritical pressure unit now building is about 8800 Btu per kwhr. Fig. 11 shows this can be reduced to 8100 Btu per net kwhr by raising the pressure to 4500 psi and the temperature to 1200 F with two stages of reheating. About half of this improvement is due to the increased temperature and the additional stage of reheating, while the other half is due to increased pressure.

The saving of 700 Btu per net kwhr is equivalent to an investment saving of about $13 per installed kw in terms of the fuel cost based on today's average price. This illustrates the large potential savings involved in this supercritical development.

Pilot test unit. In view of the possibilities indicated by these studies, B&W decided late in 1951 to build a relatively small pilot unit to operate at 5000 psi at its Alliance Research Center. Then actual experience and answers could be obtained for many of the conditions that would be encountered in the design and operation of a supercritical-pressure unit. The pilot plant is shown on page 73.

This equipment was started up in March 1953 and has been in operation most of the time since. The space taken up by the water-conditioning equipment is much greater than that used by the steam generator and its control instruments. The most advanced equipment in the way of demineralization, deaeration, instrumentation and control are installed on this unit. This is indicative of the emphasis and importance placed on proper water conditioning for this type of cycle.

Fig. 12 shows a section through the steam-generating unit. This consists of a single tube, running along the walls of a brick-lined gas-fired furnace and then forming a convection section with parallel flow of the gases and the fluid.

Several important features of design and operation have been explored with this unit during the past year. These include such things as (1) properties of the fluid (2) pressure-drop characteristics with variations in mass flow, pressure and temperature (3) response characteristics and the control required (4) heat-transfer rates of the fluid film (5) water-conditioning requirements and studies in conjunction with American Gas & Electric engineers. Information so far obtained on this pilot unit has been invaluable in carrying out the design of the first full-scale supercritical-pressure unit.

The fluid-film heat-transfer-rate apparatus is an electrically heated tube through which steam from the discharge of the once-through unit is passed and subjected to varying heat-absorption rates, pressures, temperatures and velocities to determine the film transfer-rate characteristics. This apparatus has been tested up to heat-absorption rates of more than 600,000 Btu per hr per sq ft on the inside surface. This is far in excess of anything that would be ex-

Supercritical steam generators call for design ingenuity to meet their problems

Using all the development work since 1916, extensive investigation and consideration of the type of steam generator best suited for supercritical-steam conditions had been going on for more than three years prior to May 1953. A rather effective way of showing the differences between subcritical and supercritical conditions is given in Fig. 14. This shows the heat content or enthalpy of H_2O for various pressures and temperatures.

Consider a 2300-psi unit with 1050-F steam temperature and 1050-F reheat with 500-F feedwater. On such a unit 20% of the heat absorbed is used for the sensible heating of the feedwater to saturation temperature, 32% for latent heat needed to evaporate the water, 33% for superheating the steam and 15% for resuperheating the steam.

On such a unit, if no economizer were installed, and all the sensible heating and evaporation of water were done in the furnace walls, the products of combustion would have to give up heat from the adiabatic temperature down to a furnace-exit gas temperature of 2200 F. Superheater and reheater would further cool gas from 2200 to 800 F.

If an economizer were installed, however, to do all the sensible heating after the superheating and reheating, only sufficient evaporating surface would be needed in the furnace to cool the products of combustion from adiabatic temperature to 2850 F. Of course, from a slagging standpoint, such a furnace-exit gas temperature is far in excess of what could be handled satisfactorily in a coal-fired unit. This then would call for some type of radiant superheating surface or other means to lower the gas temperature entering the convection section to acceptable levels from a slagging standpoint. Naturally, there are variations between these two limits of 2200 and 2850 F depending on amount of sensible heating of water done in an economizer.

Again referring to Fig. 14, consider the case of a cycle for 4500-psi and 1150-F steam with two stages of reheat, one to 1050 F and one to 1000 F with 525-F feedwater temperature. Here, 19% of the heat absorbed is used for sensible heating of the feedwater to the critical temperature, 705 F. There is no longer any latent heat for evaporation. Sixty percent of the heat absorption goes for superheating the steam above 705 F and 21% for the two stages of reheating. There is no problem of obtaining constant high steam temperatures over a wide range in load since there is no fixed point of surface where superheating begins. It is merely necessary to control the firing rate in relation to the feedwater flow rate to get the temperature desired.

The problem which now becomes paramount, however, is one of keeping the tubes that line and cool the combustion chamber at a low enough temperature and stress level over the entire range of load so they will give reliable troublefree operation. This requires the fluid in the tubes surrounding the combustion chamber to be as low in temperature as possible and the film transfer rate between the fluid and tubes to be as high as possible.

The fluid best meeting these specifications is the sensible heating state of the water. Using the full 19% of the heat to bring the water up to 705 F means that the gas temperature in this zone can only be cooled from adiabatic down to 3150 F, while heating the water from 525 to 705 F.

An intensive development program has assessed problems..

perienced in a commercial steam generator fired with conventional fuels.

Philo supercritical unit. In May 1953, American Gas & Electric Co, The Babcock & Wilcox Co, and General Electric Co decided to proceed with the building of a commercial coal-fired supercritical-pressure unit to be installed at the Philo Plant of the Ohio Power Co on the American Gas and Electric system. This installation has been described by Philip Sporn in an article in *Electrical World*, June 29, 1953, and in POWER, pp 84-85, Sept 1953.

Because of the pioneering involved and the many untried features throughout the entire installation, it was decided to limit its size to as small a unit as possible, while still being commercially practical and making efficient use of the reheat cycle. With these conditions in mind it was agreed that the size of the unit would be about 125 mw.

Using design factors in accordance with the ASME Boiler Construction Code, the design pressure of 5000 psi for the steam-generating equipment and the steam piping, and the temperature of 1150 F for the high-pressure steam were determined by the thickness limitations of conventional tubing made of austenitic steels for which a reasonable amount of operating experience was available.

A single stage of reheat to a temperature of 1150 F was originally contemplated. In view of the unknowns involved in the first reheat stage of the turbine, however, it was agreed to use a first reheat temperature of 1050 F and to add a second stage of reheating to 1000 F to obtain the equivalent heat rate. Feedwater temperature selected was 525 F. Fig. 11 shows the net plant heat rate for the installation is expected to be about 8500 Btu per net kwhr, depending on the vacuum obtained in the condenser.

Universal pressure design. It was evident to all those involved in the design of the Philo installation that the cyclone furnace, in addition to its many other attributes, was ideally suited for this application. It assures the complete combustion of the fuel, whether coal, oil or gas, in about one-twentieth of the furnace volume ordinarily needed for the complete combustion of pulverized coal. Because of the small amount of cooling required to line this small combustion space, the gas temperature leaving the cyclone furnace is higher than 3200 F. Furthermore, by using a full stud covering on the primary furnace surfaces, and by recirculating a relatively large quantity of cooled products of combustion to rapidly cool the combustion gas immediately after it has passed the slag discharge zone, it is possible to keep the heat absorption rates reasonably low on the surface being used for superheating, reheating.

A one-sixth-scale model of the cyclone furnaces for Philo and the mixing chamber between the furnace and the convection surface was set up at the Alliance Research Center to determine the best way to introduce and mix the recirculated gas with the products of combustion, Fig. 13.

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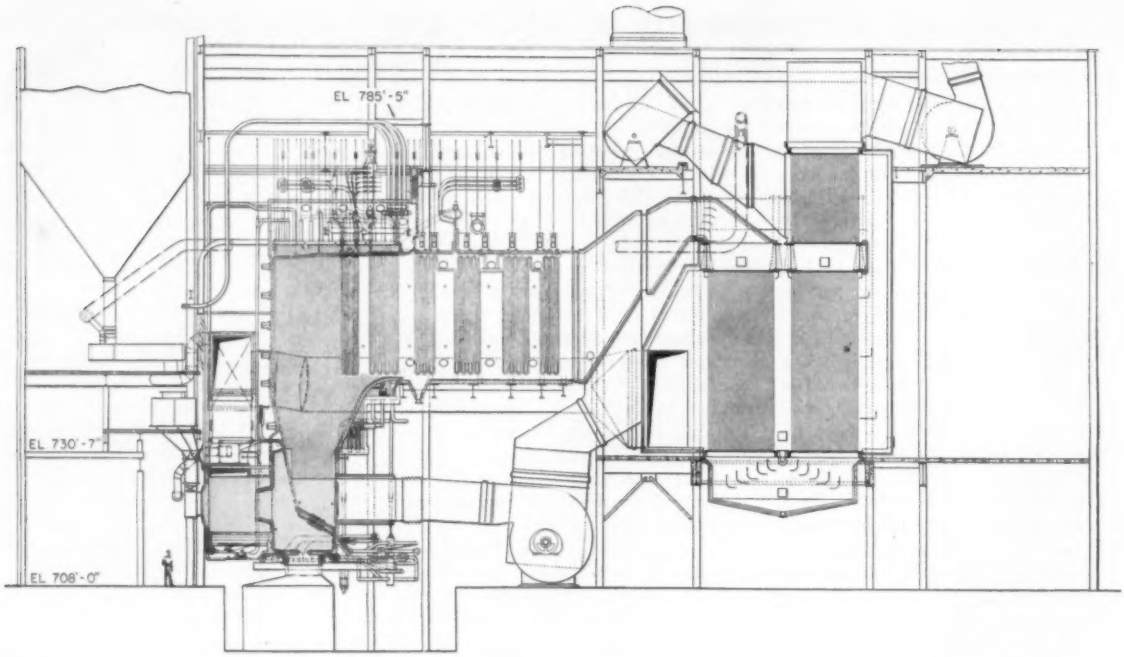


15 Philo universal pressure boiler will generate 4500-psi steam. Has two stages of reheating together with superheater sections in horizontal pass. Recirculating fan, *bottom center*, takes gas from air-heater inlet back to furnace

...and set the stage for design of the first full-scale unit

After many trials, a satisfactory arrangement was developed. This gives rapid cooling of the combustion gas and equalized gas velocities and temperatures entering the convection section. In July 1953 its adoption was decided on. From then on, the actual detailed design and fabrication of the steam-generating equipment has proceeded steadily.

Fig. 15 shows a section through part of the Philo Station where No. 1 unit is being removed and the new supercritical unit No. 6 will be installed. It will use the same building, foundations and much of the original steel work.

No. 1 unit was ordered in 1923 and was one of the first reheat units in this country. It generated 40 mw at a heat rate of 14,000 Btu per net kwhr. Here is a vivid picture of the progress made by the utility industry over the last 30 years. Three times the kw generating capacity is being installed in the same space with a 40% reduction in the amount of fuel required per net kwhr. This is one of the many striking examples of what makes America tick.

As indicated above, the feedwater enters one of the three cyclone furnaces and flows in series through each one and through the primary furnace wall. It then flows through the relatively cool primary superheater section, through the walls of the mixing chamber, and finally through the secondary superheater platens and convection zone. The two reheat sections are in series alongside the primary superheater and cover approximately two thirds of the width. The recirculated gas, taken from the entrance to the air heater, is reintroduced into the bottom of the mixing chamber just above the slag screen. The products of combustion pass through the air heater to the stack.

For the first time in history, there is more tonnage of alloy-steel tubing than of carbon-steel tubing in the steam generator.

During the development of this unit many special design considerations have had to be decided without the benefit of prior commercial experience. The test work at the B&W Alliance Research Center has, of course, been invaluable in helping to reach many of these decisions.

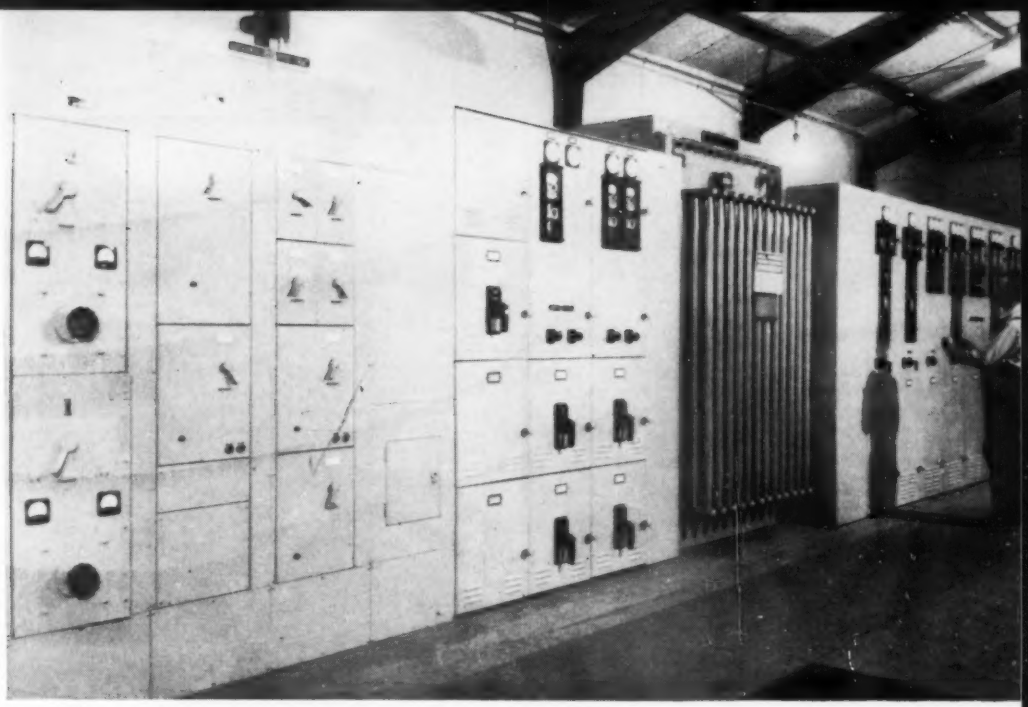
A most important key to the successful operation of this equipment is water conditioning. The indications are that it will be possible to obtain satisfactory water conditions by using practical equipment and operating methods. This, however, will require a high level of supervision during operation.

Some of the many new factors involved in this development are:

1. Heat distribution.
2. Close tube-thickness tolerances.
3. Sensitivity of response to changes in operating conditions.
4. Suitable support to take care of variations in tube temperatures.
5. The many requirements of starting up and shutting down, including shock on hot headers and steam piping and selection of satisfactory materials.
6. Welding and other fabrication techniques.

It is expected that the Philo unit will be ready for operation some time during the first part of 1956.

The sponsors of this initial commercial installation at Philo are proceeding with confidence and with firm optimism in the future of supercritical pressure and higher temperature for further improving the efficiency of generating electricity.



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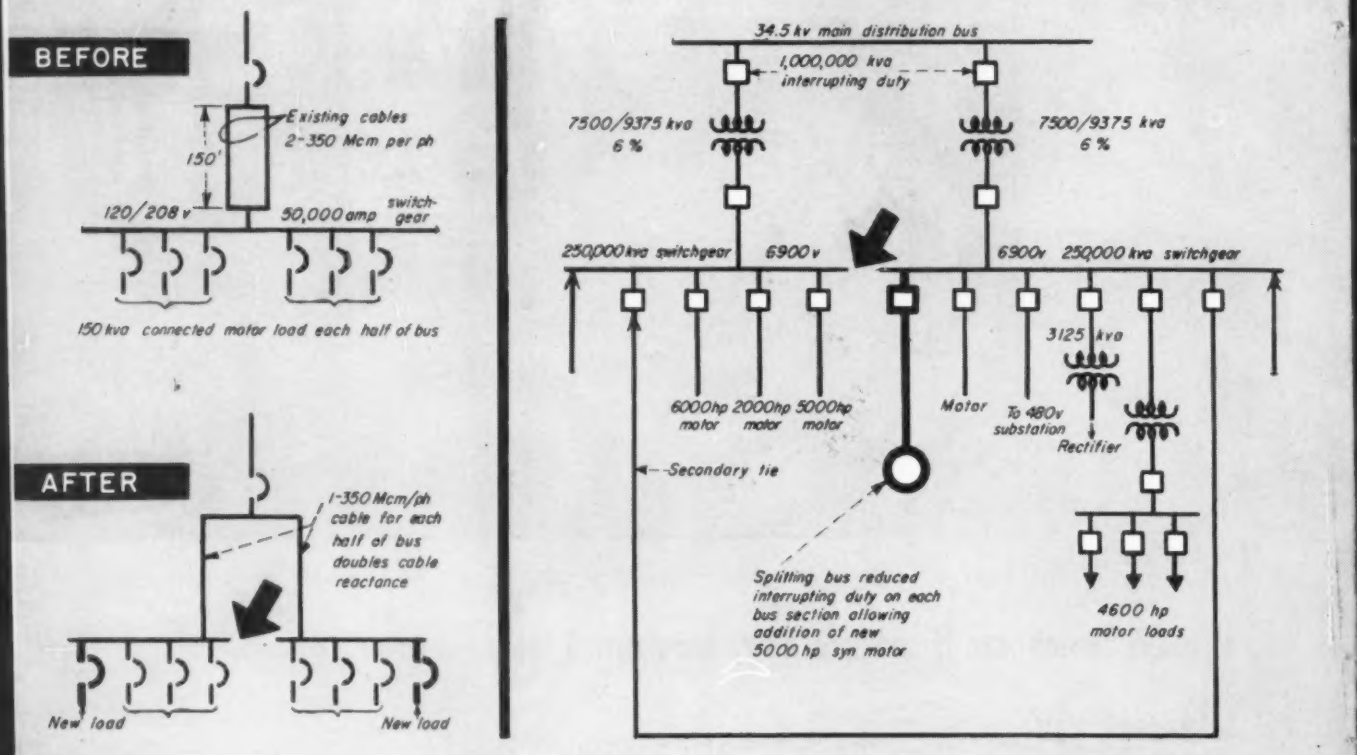
5. **Synchronizing bus ties the split sections through reactors**
6. **Duplex reactors divide current sources, throttle fault amperes**

► TO HANDLE anticipated load growth safely in the coming years, many industrial plants will be forced to expand their present electrical distribution systems. In a sizable number of such plants the existing switchgear will be quite modern and adequate within its rating. Hence, the problem becomes one of expanding by integrating present gear into the new and enlarged setup.

Where additional motor load, along with increased electrical capacity from the supplying utility or plant generators is tagged onto a distributed system, the available short-circuit current increases. Both the increased capacity of source and the added motor loads contribute to this larger available short-circuit current. When the value of available short-circuit current climbs beyond circuit breaker and fuse ratings, you are inviting major trouble. If a breaker attempts to interrupt a fault current beyond its rating, an explosion may result.

Old switchgear. Where switchgear is of old open design it is due for replacement regardless of the proposed expansion. Such plants have a simple distribution design problem since it boils down to laying out a new, larger system taking full advantage of modern techniques and materials.

In this article, however, we are considering the plant with modern metal-clad switchgear that is perfectly satisfactory within its rated limits. Such a plant should consider one or more of the six methods proposed: *split bus, reactor tie, transformer tie, unit substation, synchronizing bus, duplex reactor, as shown at left.* *Turn page*



1 **SPLITTING BUS** is simplest method to reduce short-circuit duty. Small plant, *left*, used this technique when adding new motors, holding duty within switchgear rating. Large steel plant, *at right*, split bus to add a 5000-hp motor load

Splitting the power source and introducing circuit impedance are two

Which method to select hinges on many factors: What is best utilization voltage for the added equipment? What additional expansion can be expected during plant life? What is loss per hour if an electrical outage occurs? How much does good voltage regulation mean to the system?

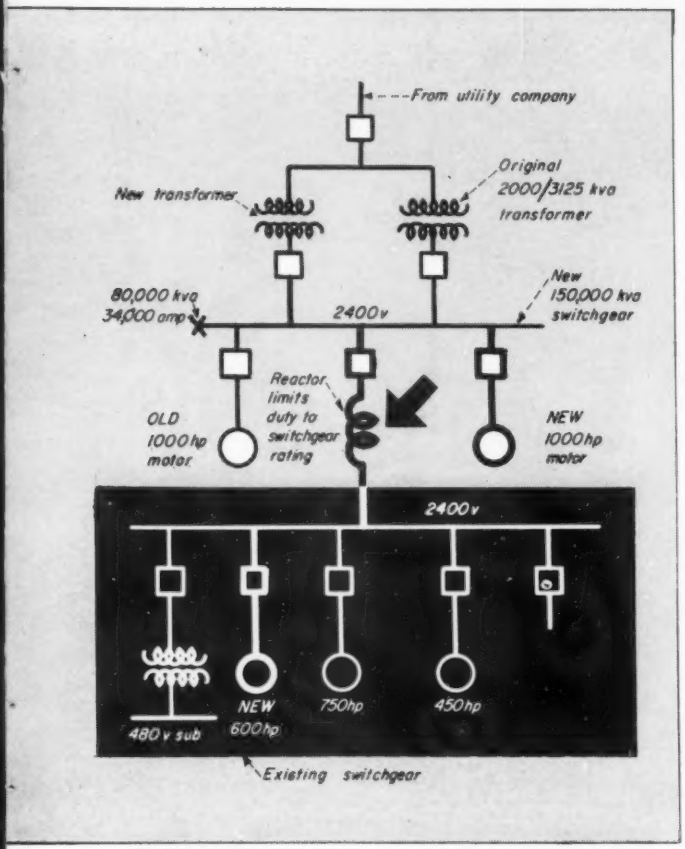
Split bus. By far the simplest way of reducing short-circuit duty on an existing bus is to divide that bus into one or more parts. Such division should be made so reactance will be added between each section and the source, limiting the fault-current duty on each bus section to the desired level. Such reactance between parts of the original bus may be added in the form of reactor, transformer, or cable impedance. Cable impedance may be added or may already exist, but it is not being used advantageously to help lower short-circuit duty.

In many plants the bus-splitting scheme is used in conjunction with some other method as discussed further on. But there are many plants where it can be used alone.

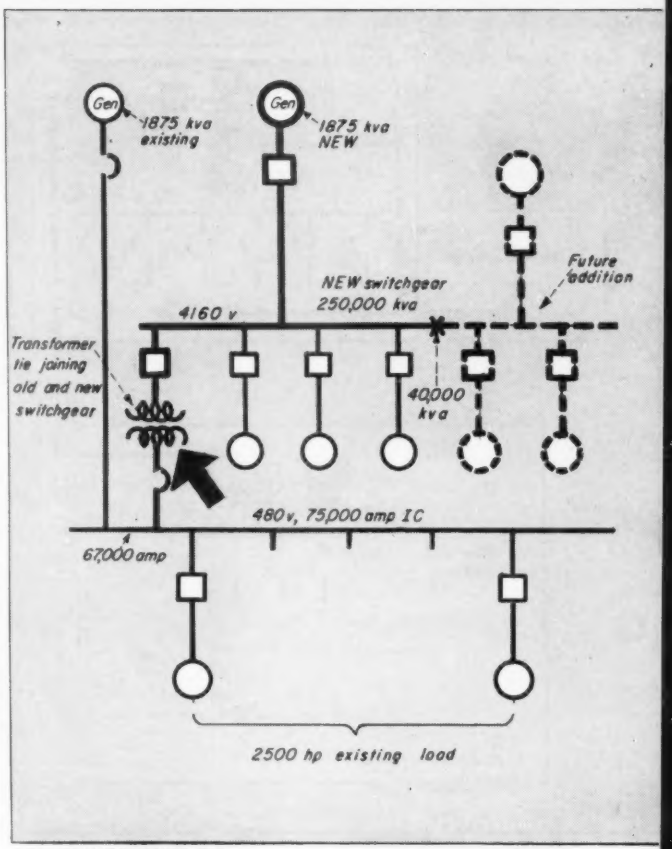
On low-voltage systems cable reactance is generally quite high per kva carried. Multiple cables usually run from the incoming source to the main bus. By dividing the bus and incoming cables as in Fig. 1, left, you can get twice as much impedance between the source and each bus section as before. At the same time there will be four times the original source-to-bus impedance between the now separated bus sections. This is important in calculating the contributing short-circuit current from motor loads.

This added impedance gained by splitting the bus and feeder cables may be sufficient to allow adding short-circuit contributing loads and yet remain within the duty limit of present switchgear. In case illustrated, Fig. 1, this technique reduced fault duty from 50,000 to 25,500 amp, thus making room for additional motor load. But you can't go too far in adding load. Theoretically many times the original kva in motors could be added before the interrupting duty is again raised to the switchgear limit. However, from a practical standpoint, voltage drop and accompanying power loss plus thermal limitations of cable will limit the increase.

On somewhat larger systems, Fig 1, right, this method can sometimes be used when two transformers feed a bus, both operating continuously and in parallel. By splitting the bus and having one transformer supply each bus section, the short-circuit duty is decreased on each bus so new load can be added. This point is illustrated above, using a steel mill as an example.



2 **REACTOR TIE** between new and existing switchgear limits duty on the present gear to within its interrupting rating



3 **TRANSFORMER TIE,** similar to reactor, joins new and existing switchgear but with new gear at a higher-voltage level

practical ways to limit possible short-circuit currents to safe values

Splitting the bus to lower the short-circuit duty and permitting more load is least costly of all methods. It requires minimum work to rearrange the circuit and calls for little or no additional space other than that for equipment needed to handle new load. Though such a technique relieves the problem of insufficient short-circuit capacity, there is often little spare thermal capacity in cable or transformers to use for new loads. This may be aggravated further when the bus is split since only half of the available power connects to each bus section. Should the demand factor on that section go up, that bus may run into thermal troubles. Motor starting may also present a problem on a split bus. In addition, you may meet up with light flicker if power and lights are taken from the same bus section.

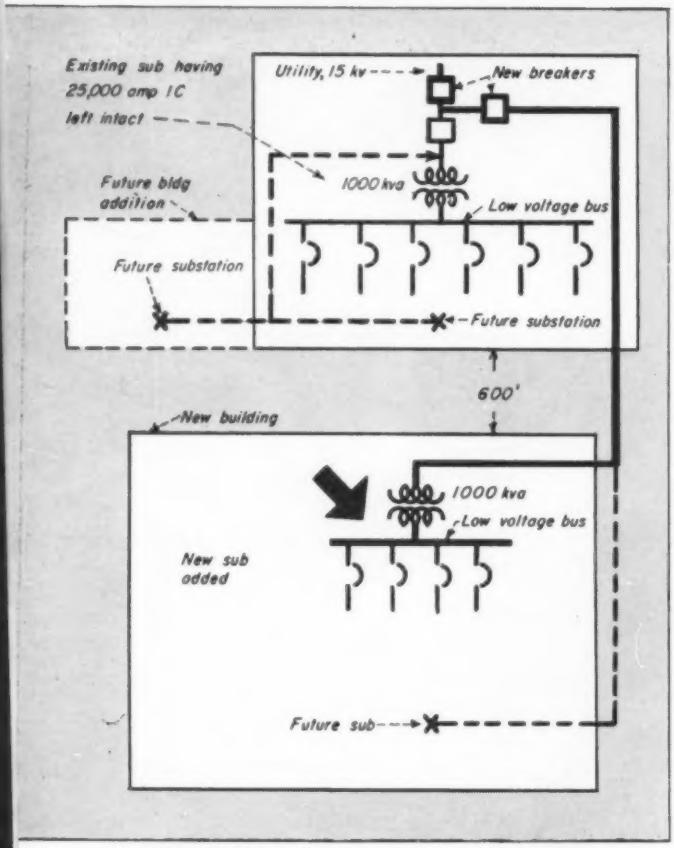
For these reasons this method is often used in conjunction with a transformer tie or synchronizing bus. However, if these are not sizable objections in your plant the split-bus method is a sound solution to your problem.

Reactor tie. Where a system is to be expanded at the existing voltage, the reactor-tie method is a relatively simple way of accomplishing your goal. Here the existing switchgear ties into the new switchgear through a reactor, sized to limit duty on existing gear to its rating or below. Old switchgear is used intact, Fig. 2, when system is expanded. Quite frequently this method is adopted in a plant having light-duty 50-mva 2.4-kv switchgear, which very quickly reaches its limit when load is added.

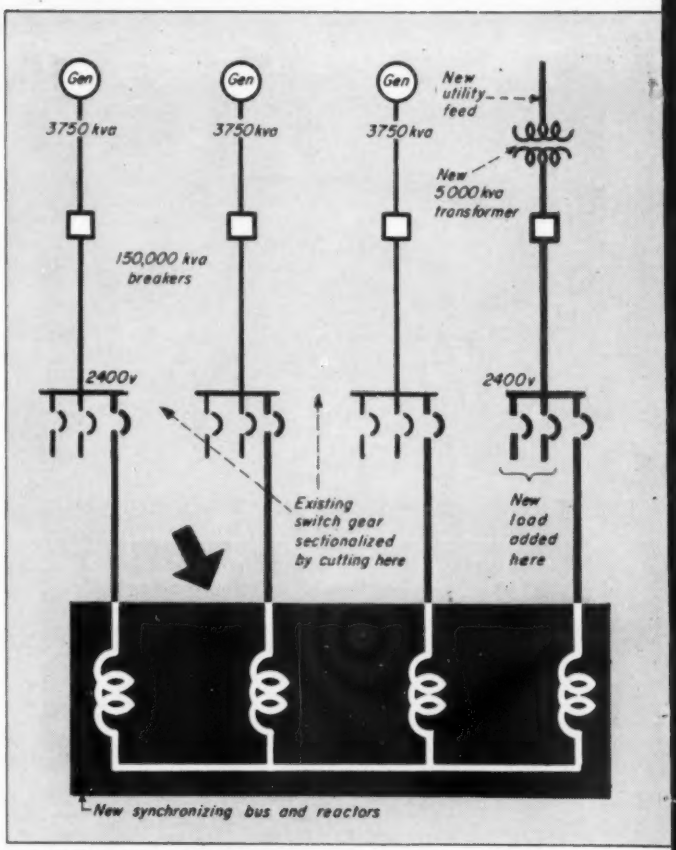
Advantages of a reactor tie boil down to its low first cost, plus ability to adapt existing switchgear with little modification. This method is generally applied where new loads are physically close to existing loads and new motor loads are similar in size to existing motors. This similarity in motor size strongly suggests that the expansion be at the same voltage level.

Disadvantages: There is some power loss in the reactor and more expense than with the split-bus method, since a breaker, reactor and bus duct must be added.

Transformer tie. Here existing switchgear joins to a new lineup of switchgear at a higher voltage and interrupting level through a transformer, Fig. 3. The plant serving as an example wanted to add 1500 hp in motors. It is apparent that a new generator of possibly 1875-kva capacity would be required to help power the new load. To add this load to existing 480-v switchgear, having an interrupting rating of 75,000 amp, would increase the duty to 86,000 amp, or about 15% over the safe limit. Solution here was to select switch-



4 **UNIT SUBSTATIONS** are core of most industrial-plant expansions. Secondary sides often connected through breakers



5 **SYNCHRONIZING BUS** scheme suitable when generation, utilization voltage is same and higher voltage not feasible

Carrying high primary voltage direct to load-centered unit substations

gear at a higher voltage, 4160 volts, and connect existing 480-v gear to the new bus with a 1500-kva transformer.

New gear at 4160-v with 250-mva rating had an interrupting duty of only 40,000 kva with the new generator and loads on it. This left room for further expansion. Existing 480-v switchgear now has its duty increased to 67,000 amp, and within the breakers 75,000-amp rating, because of the transformer that was added.

Transformer tie generally costs more than the preceding two methods. But it allows the plant to expand up to eight or ten times its previous size, which is not uncommon over a long period of time. One obstacle is often met in considering this method: the plant engineer may feel a higher-voltage system is more hazardous than existing low voltage. This is particularly the case if the plant is considering going from a low or 600-v system to a medium or 4160-v class of equipment.

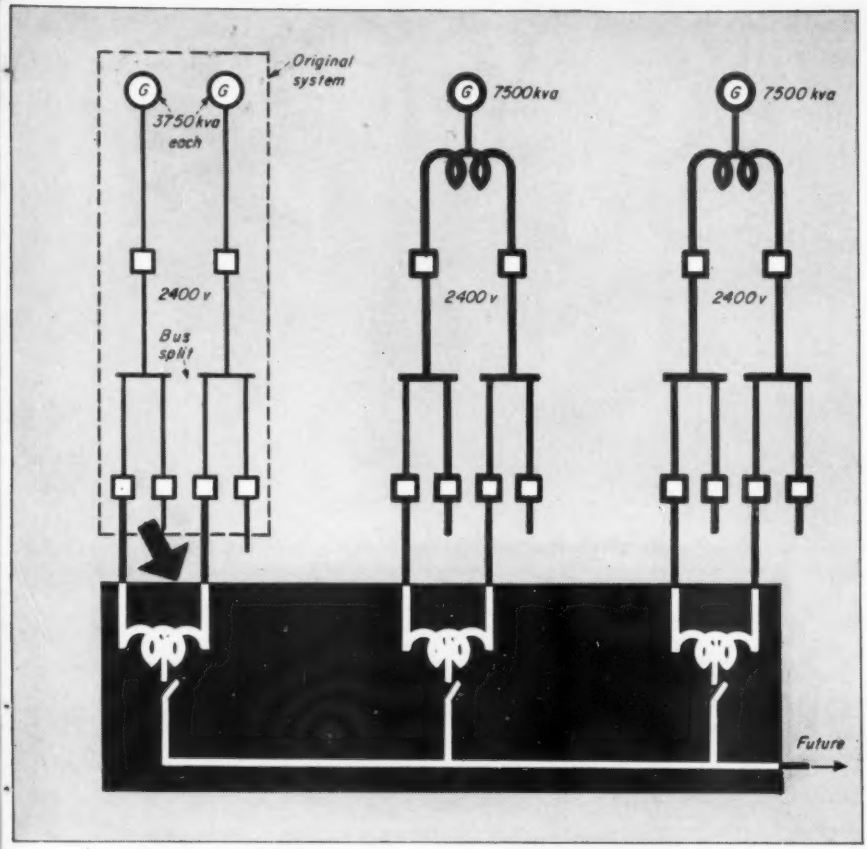
Actually this thinking is erroneous since all modern switchgear is metal-enclosed to prevent normal contact with energized parts. Repair and maintenance work is done when the switchgear is de-energized. The National Electric Code backs this up since it permits voltages up to 15 kv inside of buildings.

Unit substations. The most popular method of expanding industrial power systems today is with unit substations bringing high voltage close to new loads, Fig. 4. This technique is used most often when the new load is remote from existing loads. Such is the case when there is an addition to an existing building or plant area. It is most widely applied to systems having utilization voltages in the 600-v class.

Using unit substations, the existing switchgear remains as is. Thus there is no danger of increasing its duty. Big advantage is in savings in cable, reduced power loss, voltage regulation.

Synchronizing bus. Where utilization and generation voltage are the same, and it is not feasible to go to a higher voltage, consider a synchronizing bus. This is installed as shown in Fig. 5. Existing bus is sectionalized; then all bus sections are connected through reactors to a common bus. Hence, interrupting duty is greatly reduced on existing breakers. Furthermore, this installation allows adding new loads and additional incoming capacity. Power is automatically transferred between bus sections if normal source of power to one section fails.

With a synchronizing bus, further expansion is almost unlimited. However, keep in mind that it is usually not possible to put breakers directly on the synchronizing bus since the interrupting



6 **DUPLEX REACTOR** can be used on systems with large power sources compared to their utilization voltage. Reactors divide such sources, throttle short-circuit amp

Design tips for electrical expansion

► High distribution voltage carried close to load cuts cable costs and gives you better voltage regulation

► Avoid double - voltage transformations: say, 13,800 to 4160 to 480. Savings can run to 10% per kva of transformer capacity

► Keep system simple and you'll reduce operating errors and initial cost

► Use reactance, if necessary, to hold interrupting duty within the range of the existing switchgear

proves most popular when expanding today's plant distribution systems

duty on it is much higher than on the section buses. If this method is used, take care not to establish loop feeders from one bus section to another that might bypass the reactors.

This method of system expansion is flexible and the primary source of power for any bus section can be taken out of service for maintenance, inspection, or when it is not economical to have it operating at light load. Where normal feed to a section is killed, that section will then be automatically fed by other power sources through the synchronizing bus.

This arrangement is most frequently found in industrial power plants having large systems in the medium-voltage class where 500,000-kva switchgear is the highest rating manufactured without going to station-type gear. Such a system must be sectionalized to stay under that gear rating for the plant.

There are a few disadvantages: space required for the synchronizing bus, power loss in reactors, voltage regulation on a bus section getting power from another section.

Duplex reactors. Where systems have large power sources compared to their utilization voltage (example: adding a 10,000-kva generator to a 2400-v bus), a duplex reactor scheme may be the answer. Here the new generator, plus the motors on the bus, gives a momentary duty of 70,000 amp when only 60,000-amp breakers are available. It may also be used where utility or plant-generated power is brought into the system at current values above available breaker's continuous current ratings.

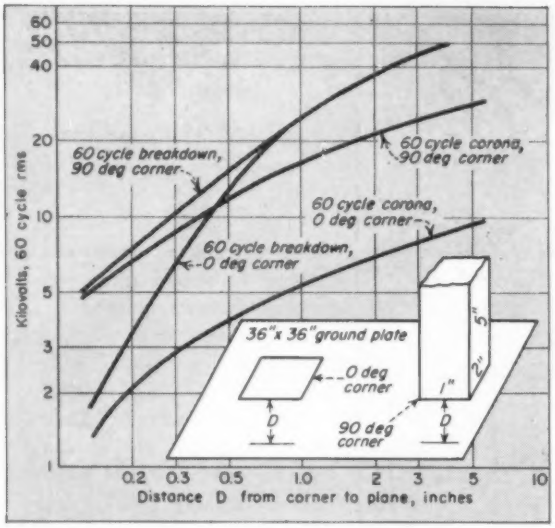
Like the synchronizing bus method, duplex reactors are generally used where there is a heavy concentration of load: (1) in the power house (2) where plants generate their own power (3) where utilization and generation voltage is the same and there is a large load best served at the same voltage.

A duplex reactor is simply a center-tap reactor used to divide current sources and throttle magnitude of fault currents, Fig. 6.

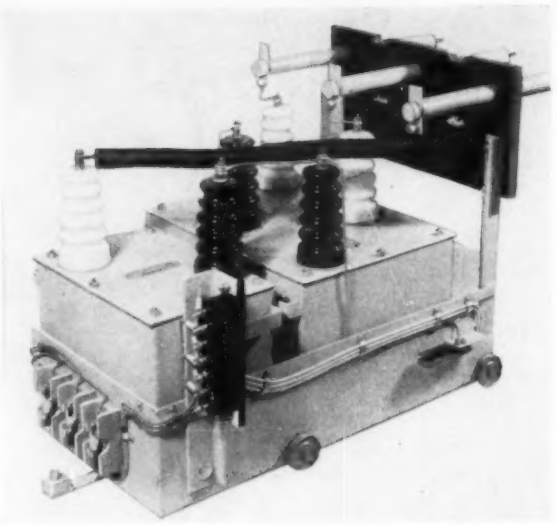
System design. Methods described in this article are flexible tools for the designer of industrial-power distribution systems. In many plants, two or more of these methods may be used to arrive at the best way to expand the system, yet make use of present switchgear.

Keep in mind that a plant expansion need not all be made at the same time. Frequently expansion can be handled on a step-by-step basis as money is available. However, the first step is to draw up a plan or one-line diagram of what the ultimate system is to be. Then

(*Continued on page* 192)



CONDUCTOR GEOMETRY, working voltage have pronounced effect on corona. Round corners on high-voltage conductors help



EFFECTIVE SPACING of fuse holder in potential transformer was increased with Bakelite clamps in place of metal flanges

Corona-free switchgear: bigger factor

Making switchgear corona-free is ordinarily a manufacturer's problem. But when gear is revamped on the job during a plant expansion, follow these design tips to keep out of trouble

By **CARL E MERCIER,** *Switchgear Dept, Allis-Chalmers Manufacturing Company*

► IN SIMPLE TERMS, corona may be defined as ionization of the dielectric material surrounding a conductor. It occurs when the insulating material is overstressed by high voltage. In switchgear, corona is most likely to be found in the air adjacent to high-voltage buses, bushings, and other locations where small air gaps are present.

Corona troubles. Corona can be destructive. It produces oxygen in the free state in addition to various nitrogen compounds that readily attack lead-covered cable. In time, the lead covering may powderize into lead oxide and basic lead nitrates. Copper and silver are also attacked.

Corona can be particularly serious on silver-plated contacts where corrosion may increase contact resistance, causing excessive heating. With moisture in the air, corona produces nitric and nitrous acid. These acids not only corrode most metals, but also rapidly deteriorate insulation. High temperatures or hot spots produced by corona speed up insulation aging process, in turn lowering dielectric strength.

Corona brings about other bad effects. If present in switchgear, it produces an undesirable high-frequency signal, which may travel long distances interfering with radio, communication, and television reception. Further, since corona is at random frequencies, it is difficult to filter it from transmission lines. *Only sure solution known today is to eliminate the corona source.* So modern switchgear designers use extreme care in designing switchgear bus and other high potential components.

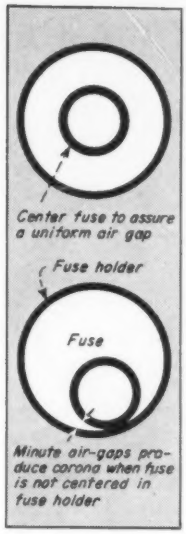
As indicated in the box on facing page, there are five practical methods of eliminating corona; *increase spacing, improve geometric configuration, provide shielding, improve voltage distribution, eliminate air gaps—electrically or mechanically.*

Increase spacing. First logical step to eliminate corona in uniform electrostatic field is to increase air gap. Thus, applied voltage won't exceed air gap's critical gradient. This may be difficult where design fixes spacing. Often the air gap can be increased by decreasing amount of solid insulation.

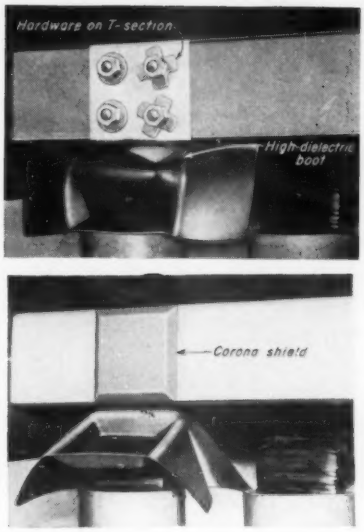
Where quantity of insulation is reduced it generally means adopting a new insulation with higher dielectric strength. Here's a good rule: Use only enough solid insulation to adequately insulate at test voltage yet maintain an air gap sufficient for high corona level.

Where the electrostatic field is not uniform—adjacent to sharp edges, corners, and small cylindrical high-voltage terminals—it is good practice to add air-free solid insulation. Even though this decreases the air gap, corona level is increased because of greater effectiveness of the solid insulation in high-stressed, nonuniform fields.

Geometric configuration. Space limitations often make it impossible to increase air gap for plane surfaces or to add insulation around high-voltage conductors where the field is nonuniform. Here switchgear designers resort to other methods of decreasing dielectric stress. One way is to change geo-


Center fuse to assure a uniform air gap
Fuse holder
Fuse
Minute air-gaps produce corona when fuse is not centered in fuse holder

CENTERING FUSE in holder eliminates minute air gaps, increasing corona level



BRASS SHIELD, neoprene boot over bus tap raise corona level from 13 to 36 kv

CONDUCTING PAINT on inner lining of bus-bar cover assures high corona level

as plant voltages continue to climb

metric configuration of the device. Sketch above shows effect of a geometrical change on an air gap. Remember, dielectric of solid insulation is determined more by its volts-per-mil rating, whereas air-gap strength is to a greater degree affected by conductor geometry. Often minor configuration changes result in major improvements in corona level. Good design practice rounds off sharp corners that might undergo high-voltage stress.

Shielding is still another way of eliminating corona. Shields are placed over conductors having high stress points. Usually geometric correction is less costly; shielding is adopted where suitable shapes are impractical. Typical would be the high-corona-level T joint for switchgear using a special design shield, *above*. These T sections are on main buses of switchgear units. Shield is placed over T section to eliminate high-stress points at threads and corners of hardware. Shield is used with a high-dielectric-strength boot. This shielding raises corona levels from 23 to 36 kv.

It may be practical and profitable to use shields on old design switchgear having low corona level because of poor conductor geometry. But to make the shield effective you may have to tie it electrically to the conductor.

5 ways to eliminate corona in switchgear

1. Increase spacing by using high-dielectric strength insulation and increasing the air gap
2. Check conductor geometry where air gap can't be changed. Often a change in shape does the trick
3. Use shielding over high-stressed conductors where it's not practical to use suitable shapes
4. Dielectric constant of insulation in series with air gap has pronounced effect on voltage stress
5. Reduce high-stressed air gaps either mechanically or electrically (*photo above, right*)

Low dielectric constant. Complicated configurations can usually be broken down into an equivalent circuit.

Dielectric constant for insulation, in series with an air gap, has a pronounced effect on voltage distribution. For a given air gap in series with a solid insulation, an insulation that has a low dielectric constant is preferred in order to keep the air stress to a minimum.

Where a series insulation circuit consists of a solid dielectric and an air gap, the lower the dielectric constant of the solid insulation, the lower the air-gap stress. And, conversely, the higher the dielectric constant of solid insulation, the higher the air-gap stress.

Eliminating air gap. Since corona usually occurs in air gaps adjacent to high-voltage conductors, it can be eliminated by mechanically eliminating the air gap. This can be done by filling the air gap with high-strength air-free insulation, such as transformer oil, casting resin, sealing compounds. To assure air-free bonds, insulation should conform to terminal surfaces bordering the air gap. Example: high-voltage potheads and current transformers filled with compound. Casting resins are ideal for filling air gaps.

Where high voltage exists across small air gaps, suspect corona. If both surfaces bordering air gap are of equal voltage, this gap is electrically eliminated. This can be done by lining both surfaces with metal foil or conducting paint, photo above, and then connecting these coated surfaces electrically. When using this method, terminate ends of metal foil or semi-conducting paint to eliminate corona at edges. To do this apply insulating filler over these edges.

FIRST OF A SERIES

By
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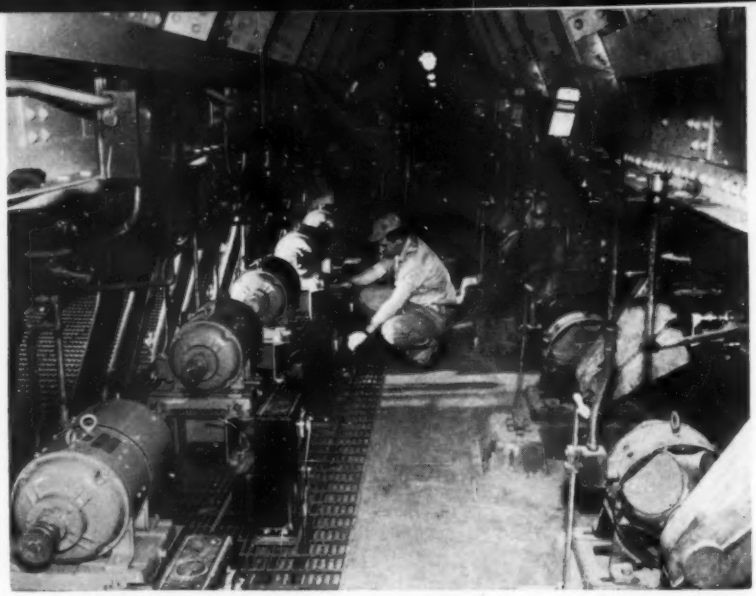
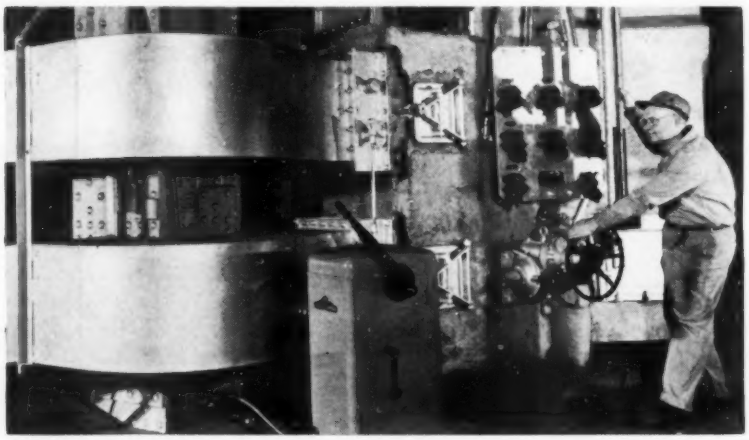


6 COAL FEEDERS for boiler No. 2 are at left in center aisle between boilers. Air-control drives for primary-air butterfly valves are adjacent to the feeder motors



BLAST-FURNACE-GAS supply to one corner burner. Control drive, *center*, operates dampers in the gas lines to prevent flashbacks. Same setup in all four corners

Since construction in 1920, world-famous Rouge Power Plant has consistently taken the lead in pioneering more efficient industrial power. In this article two project engineers tell . . .

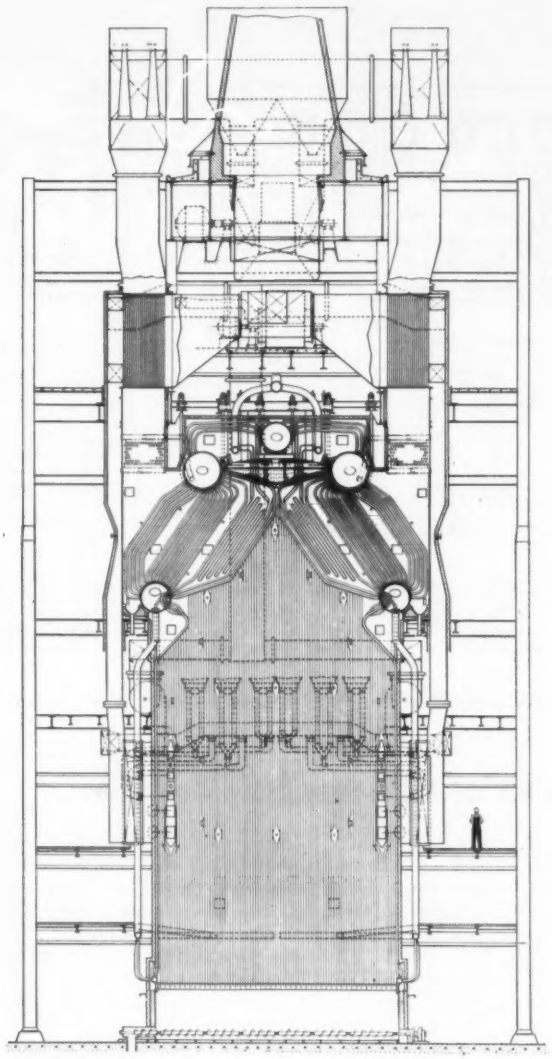
'How we engineered Ford's biggest

► MODERNIZING industrial-power facilities has come in for its full share of discussion at recent technical-society meetings—and for good reason. Production costs continue to rise. Management wants to reduce costs, or at least hold the line where and when it can. So when smart engineers give the dollars-and-cents facts to management, the decision to modernize becomes a matter of simple arithmetic.

To the Ford Motor Company such procedure isn't exactly new. In fact, it's something of a tradition. Since construction of the Rouge Power Plant in 1920, Ford engineers have replaced or are replacing all except one of the original boilers—nearly quadrupling original capacity. All this accomplished within the same floor space occupied by the eight original units! The present program includes (1) replacing three low-pressure units with three 600,000-lb-per-hr steam generators operating at 250 psi, 650 F (2) installation of dust collectors, flyash and bottom-ash handling equipment for all eight units, including 600-ton flyash and 150-ton bottom-ash storage silos (3) addition of 200,000-gph hot-lime softener system with filters, hot-zeolite softeners, low-pressure boiler-feed pumps, and 1,500,000-lb-per-hr deaerating heater.

The Kuljian Corporation, Philadelphia, has been awarded a "turn-key" contract for complete designing, engineering, purchasing, construction for the Rouge 1954 modernization program. This work is under supervision of J A MacAlarney, director, plant engineering office, manufacturing staff of Ford Motor Company. In this first of three articles we'll take a close look at the steam generators, their associated controls and auxiliary equipment. Also, we'll discuss some unusual features and solutions to problems that you may be able to put to work in your plant.

Steam-generating unit No. 2. While the steam generated



TWIN BOILERS are installed over common watercooled furnace. Each boiler connects to common dry drum; separate superheaters

FORD'S ROUGE POWER PLANT

Case history of an industrial-power pioneer

1920 **Four 200,000-lb-per-hour boilers. Largest built up to that time. First big units to use pulverized coal as primary fuel**

1923 **Four more units added. Design similar to original ones**

1925 **Peak capacity of four units is boosted to 500,000 lb per hr each by lining the original solid-wall furnaces with steam-generating and steam-superheating surface. Number of burners also doubled**

1931 **Two 700,000-lb-per-hr 1400-psi 750-F units replace two original ones. Ford sets new record for largest unit installed**

1936 1939 **Two original units remaining are replaced with largest-capacity high-pressure units in the world—900,000 lb per hr, 1400 psi, 900 F**

1954 **Ford embarks on new industrial-power modernization program**

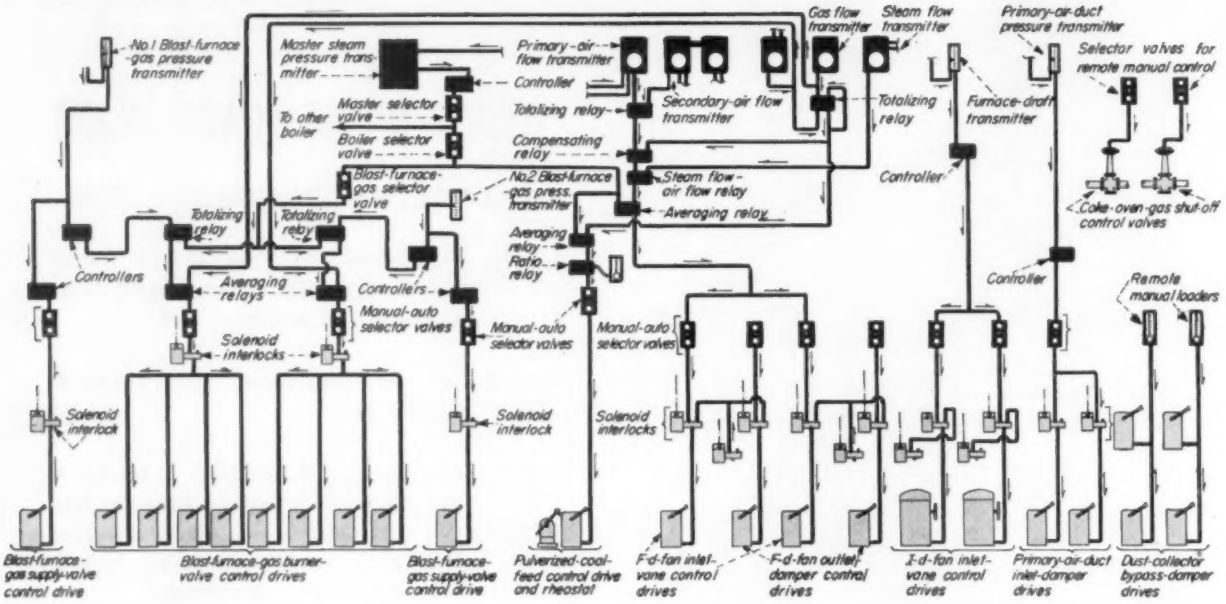
industrial-power modernization'

by the high-pressure units is now used solely for the purpose of electric generation, the low-pressure units provide steam for driving turbo-blowers, process purposes, building heating, and other plant uses. Low-pressure steam generator No. 2 has just been put in service. Designed to operate at 250 psi, 650 F, the unit consists of 2-drum bent-tube boilers (so-called twin boilers) over a common watercooled furnace. Each upper drum connects to a common dry drum, which in turn feeds separate superheaters. Two economizers and two tubular preheaters complete the heat-transfer surface.

Blast-furnace gas and coke-oven gas, in addition to pulverized coal and oil (future), are burned in a tangentially fired furnace from a bank of burners in each corner. Burning byproduct gases gives Ford engineers top fuel economy from these units. Coke-oven gas is primarily for pilot flame, but for warming up and over weekends it also enriches the blast-furnace gas. Gas pressure is regulated so all other users in the plant get priority and the boiler house uses surplus. Maximum steaming capacity when firing blast-furnace gas is 500,000 lb per hr.

Pulverized coal from the existing bin system reaches the furnace through 12 feeders, see photo at top of p 88. Two primary air fans equipped with inlet-control dampers and outlet shutoff dampers deliver primary air to pulverized-coal line below each feeder. Maximum steaming capacity when burning pulverized coal is 600,000 lb per hr.

Draft fans. Two double-inlet forced-draft fans, with inlet-vane controls and remote-manually-operated outlet dampers for low loads, discharge air to a common plenum chamber. Two induced-draft fans with inlet-louver damper controls deliver flue gas to the base of an existing 168-feet-high steel stack. Each boiler emits flue gas through its own stack.



HOOKUP DIAGRAM shows how signals from primary elements act on combustion controls to maintain efficient boiler operation

Combustion controls, interlocks yield top boiler efficiency, safe operation

After considering the alternatives, we decided on air-operated automatic combustion control for pulverized-coal and blast-furnace-gas firing. Future plans also call for automatic firing of bunker-C fuel oil. So that system repair or maintenance will not affect continuous operation, the controls may also be manually operated. To see how system works, let's trace out diagram above.

Pulverized-coal firing. Fuel supply and forced draft are steam-pressure responsive through the master controller. F-d inlet-vane position is set by steam-flow to air-flow ratio to give maximum combustion efficiency. I-d inlet-louver control drive follows furnace-draft changes to hold a predetermined draft setting at a specific furnace point.

Variable-speed motor drive on coal feeders regulates coal supply. Smart arrangement of feeder starting controls regulates so groups of two feeders can fire opposite corners of a pulverized-coal elevation at the same time. If current to feeder motor fails, a solenoid-operated air pilot valve functions to cut off primary air to feeder.

Inlet-damper-controlled primary-air fans are duct-pressure responsive to maintain a set pressure regardless of the number of coal burners in operation.

Blast-furnace-gas firing. Because other departments show a greater margin of savings with this fuel, the boiler house gets only the excess. This is achieved through gas-pressure regulation. Setup to control steam pressure, forced draft, and induced draft is like pulverized-coal system. It also operates same control drives.

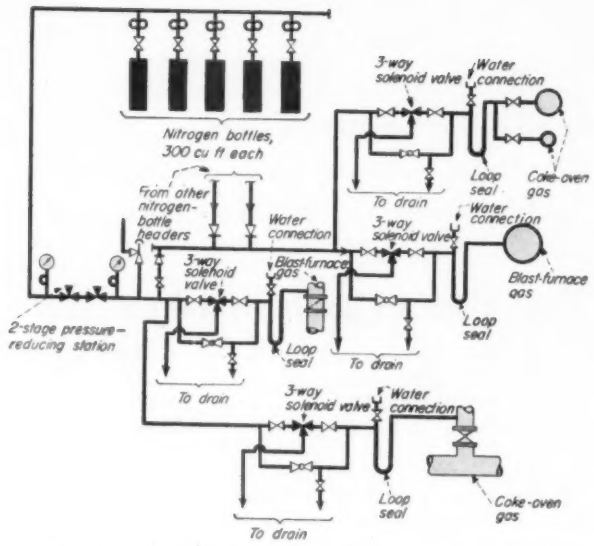
Flow control of blast-furnace gas is through eight 24-in. butterfly control valves, each feeding a burner. Here, we had to assure a *constant* pressure before the control valves. Faced with a *varying* gas-supply pressure we hooked up two 36-in. butterfly valves, one in each branch feeding the unit. Also, a remote-manually-operated shutoff damper next to each burner prevents flashbacks.

Coke-oven-gas firing is by manual adjustment of air register based on an orsat reading. One valve automatically controls pressure for each bank of coke-oven-gas burners.

To safeguard operators and equipment we interlocked f-d, i-d, primary air, and fuel supply with these steps:

(1) Failure of both i-d fans stops both f-d fans, leaving all dampers and vanes wide open. Failure of one i-d fan closes its own inlet louver, stops the paired f-d fan, and closes the f-d fan's inlet vanes. Remaining pair of fans automatically adjust to carry their maximum percent of load. Fuel-feed rate automatically reduces to match this percentage. (2) Failure of any coal-feeder motor interrupts power supply to the group of two feeders in which the defective motor belongs. If one of the primary-air fans cuts out, its inlet louver damper closes and two groups of coal feeders shut down. Firing rate then automatically cuts back to a safe level. Failure of both primary-air fans takes all coal feeders out of service. (3) Cutoff of blast-furnace gas closes all gas-flow control valves and energizes an annunciator circuit. Also, we can set l-p alarm switches. (4) If coke-oven-gas pressure drops below a set value in the burner supply lines, this fuel is shut off and an annunciator circuit closed.

(5) For all fuels: failure of both f-d fans shuts down all fuel feeds, one i-d fan, and both primary-air fans. If only one f-d fan cuts out, its inlet vanes close, paired i-d fan shuts down and its inlet louver damper closes. (6) One of the most important functions of a good interlocking system is to insure a safe starting sequence. Here's our scheme: To start the f-d fans, either one or both i-d fans must be running. If we're firing pulverized coal, primary-air fans start next, and after a 15-sec time-delay relay runs its course, the coal feeders start in groups of two. When burning blast-furnace gas, fuel-control valves open after f-d and i-d fans are operating. (7) We've tied primary-air butterfly valves to coal feeders so the butterfly valve is open only when the paired feeder is running. A time delay holds valve open 15 seconds after coal feeder shuts down.

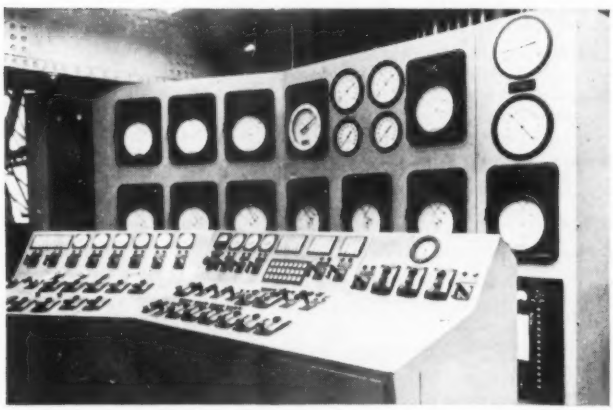


300-CU-FT CAPACITY nitrogen bottles purge fuel-gas lines

Byproduct nitrogen purges fuel lines

Nitrogen being a byproduct at the Rouge plant, we decided to use it for purging the blast-furnace-gas lines. Purging these lines is necessary not only for maintenance purposes but also for snuffing out an occasional flashback in one of the blast-furnace-gas headers before any great damage takes place. A pushbutton panel near the main exit from the boiler house can operate any of the solenoid valves required to purge any branch or header.

Diagram shows how five bottles, each containing 300 cu ft of nitrogen at high pressure, are racked and manifolded into a header. Pressure-reducing station cuts back nitrogen pressure to 15 psi in two stages. A 3-way solenoid valve then feeds nitrogen through a water loop seal into a branch of the blast-furnace-gas main. Each branch has its own rack of nitrogen bottles, p-r station, solenoid valve and water seal. Water entering the loop seals discharges through the 3-way solenoid valve to the drain. When a solenoid valve is energized, its corresponding loop seal is blown out by the nitrogen. Solenoid is reset manually after it is energized. Coke-oven-gas mains are purged with the same setup.



CONSOLE and VERTICAL panels simplify control operations

Centralized control room

This nerve center of all major automatic operations serves steam-generating units No. 2 and 4. Future plans call for a similar setup for units No. 6 and 8. Fully equipped with an intercom system connected to operator locations, the control-room supervisor gets a complete first-hand picture of the entire operation. He has at his fingertips all equipment needed to take appropriate action as boiler-room conditions vary. We've tabulated, below, instruments on the vertical and desk panel for one boiler- and master-control board.

BOILER AND MASTER CONTROL-BOARD INSTRUMENTS

Vertical-panel instruments

Unit No. 2 and Master

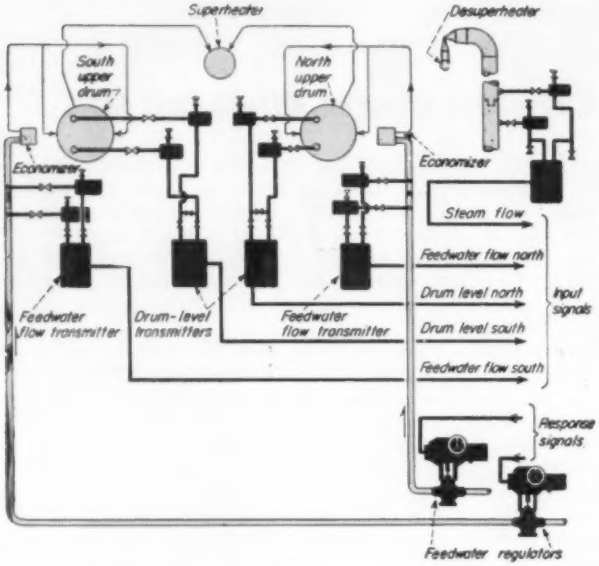
1. Steam-flow, air-flow recorder
2. Feedwater-flow-north, drum-water-level, drum-pressure recorder
3. Feedwater-flow-south, drum-water-level, superheater-outlet-temperature recorder
4. Feedwater-temperature recorder, 3 pen
5. Air-temperature recorder, 3 pen
6. Flue-gas temp recorder, south side, 3 pen
7. Flue-gas-temp recorder, north side, 3 pen
8. Smoke indicator and recorder
9. Oxygen indicator and recorder
10. Drum-pressure gage
11. Superheater-outlet-pressure gage
12. Boiler-feedwater-pressure gage, south
13. Boiler-feedwater-pressure gage, north
14. Blast-furnace gas-flow recorder
15. Steam-pressure and temperature recorder
16. Soot-blower sequential control panel
17. Electric clock
18. Steam-header-pressure gage
19. Master steam-pressure recorder controller
20. Bearing-temperature monitor

Desk-panel instruments

Unit No. 2 and Master

1. I-d fan inlet-louver-control selector valves
2. F-d fan outlet-damper-control selector valves
3. F-d fan inlet-vane control selector valves
4. Dust-collector bypass-damper remote-control valves
5. Primary-air-fan inlet-damper-control selector valve
6. 10-point draft gage, gas pressures
7. Control switch, signal lights, ammeter and nameplate for: i-d fans, f-d fans, primary-air fans, coal feeders
8. Control switch, signal lights and nameplate for nonreturn valve, steam-lead gate valve, secondary-air fans (dust collectors), desuperheater pumps, boiler-feed gate valves, boiler-feed bypass valves
9. Ignition signal lights and nameplate for: coke-oven-gas burners, coal burners, blast-furnace-gas burners
10. Annunciator panel
11. Annunciator reset and test light
12. Burner-tilt control switch
13. Burner-tilt position indicator
14. Burner-tilt motor-overload indicating lights and nameplate
15. Master selector valve
16. No. 2 boiler-rating selector valve
17. No. 4 boiler-rating selector valve
18. Combustion-control-air pressure gage
19. Coal-firing-rate selector valve
20. Blast-furnace-gas firing-rate selector valve
21. 6-point draft gage, burner-windbox and air-preheater air pressures
22. 3-point draft gage, blast-furnace-gas, furnace-draft and primary-air pressures
23. 4-point draft gage, boiler-water level, steam pressure, and temperatures
24. Blast-furnace-gas selector valves
25. Steam-temperature valve, desuperheater
26. Feedwater-level selector valves

Turn page



DRUM water level is held almost constant with this hookup

Three elements insure right drum level

Plus or minus ¾ in. of normal drum level is held with the sensitive 3-element-control system shown at left. Sensing methods include boiler-drum level—two elements; steam flow from boiler—common element; feedwater flow to boiler —two elements. Two separate feed lines, taken from a 12-in. loop header serving all the l-p units, are controlled with individual feedwater regulators. Hookup drawing shows control lines to and from control room.

PRINCIPAL POWER-PLANT EQUIPMENT—PART I: STEAM-GENERATING UNITS

Rouge Plant, Power House No. 1, Units No. 2, 4, and 6, Ford Motor Company, Dearborn, Mich.

STEAM-PRODUCTION EQUIPMENT

Steam generators, 3 ..... Combustion Engineering, Inc
600,000 lb per hr, 250 psig, 650 F. Twin boiler: 46,500 sq ft heating surface, waterwalls 19,220 sq ft heating surface, 40,400 cu ft furnace volume, 320-psig design pressure. Arranged for pulverized coal, coke-oven gas, blast-furnace gas, and oil. Superheaters: 2 per unit, rolled-joint pendant. Desuperheaters: 1 per unit, steam-assisted spray. Economizers: 2 per unit, continuous loop, finned hor tube, 4590 sq ft heating surface ea. Air preheaters: 2 per unit, one-pass air, tubular, 25,100 sq ft heating surface ea. Burners per unit: 12 tilting pulverized coal, 8 blast-furnace gas, 16 coke-oven gas, 8 oil. Four-corner tangential arrangement, including hand-operated air regulators

Coal feeders, 36 ..... Combustion Engineering, Inc
Duplex, at outlet of pulverized-coal bunkers, 2¾ hp, 2000/500 rpm, 250-v dc, adjustable-speed motor

Primary-air fans, 6 ..... American Blower Corp
27,000 cfm, 345 F, 10-in. wg, 1200-rpm constant-speed motor

Fans, 6 f-d, 6 i-d ..... American Blower Corp
F-d fans: Constant speed, inlet-vane control, 96,000 cfm, 100 F, 9.1-in. wg, 1175 rpm. I-d fans: Constant speed, inlet-louver control, 258,000 cfm, 475 F, 10.0-in. wg, 585 rpm

Soot blowers ..... Diamond Power Specialty Corp
Air operated, sequential from control room, steam blowing. Furnace: 20 short retracting. Boiler and superheater: 22 units. Economizer: 8 units

Desuperheater feed pumps, 2 ..... Byron Jackson Co
Centrifugal, 4-stage, 225 gpm at 375-psi discharge press., 180-F condensate, flooded suction

Chemical-feed pumps (6) and tanks (2) ..... Milton Roy Co
Duplex, 20.8 gph max ea cyl, 525 psig, 70 F, 125-gal steel tank with agitator, sodium metaphosphate and sodium-nitrate solution

INSTRUMENTS AND CONTROL SYSTEMS

Desuperheater-pump recirculating system
Smoke-density recorders, 3
Temperature recorders
Oxygen recorders, 3
Draft gages
Steam pressure and temperature recorder ..... Bailey Meter Co
Flowmeters
Feedwater regulator and control
Combustion control
Boiler-instrument panels

Chemical-feed control system ..... Hagan Corp

Electrical switchgear ..... General Electric Co

Motor starters, 12 ..... Electric Controller & Mfg Co

Motor-control centers, 5 ..... Clark Controller Co

Dc circuit-breaker and control panels ..... Westinghouse Electric Corp

Auxiliary relay panel, 1 ..... Allen-Bradley Co

PIPING SYSTEM, UNIT NO. 2 ONLY

Fabricated piping ..... Blaw-Knox Construction Co; W K Mitchell & Co

Hangers, anchors and supports ..... Grinnell Company, Inc

Expansion joints ..... American District Steam, Inc; Moisson Packing & Rubber Co

Valves ..... Automatic Switch Co; Beaumont Birch Co; Chapman Valve Mfg Co; Coon-De Visser Co; Crane Co; Edward Valves, Inc; Henry Pratt Co; Henry Vogt Machine Co; Leatherman & Co; Ohio Injector Co; Ruggles-Klingemann Mfg Co; Schutte & Koerting Co; Sheffler-Gross Co

Pipe, fittings, etc ..... Bailey Meter Co; Chas F Guyon, Inc; Coon-De Visser Co; Crane Co; Elliott Co, Inc; Harry W Taylor Co; I Burack, Inc; Revere Copper & Brass Co; Smith-Matthews Foundry Co; Taylor Supply Co; The Parker Appliance Co; United Conveyor Corp; W T Andrew Co

Piping insulation ..... Armstrong Cork Co

MISCELLANEOUS, UNIT NO. 2 ONLY

Pressure switches ..... Mercoid Corp; R L Deppmann Co

Welding inspection .... Hartford Steam Boiler Inspection & Insurance Co

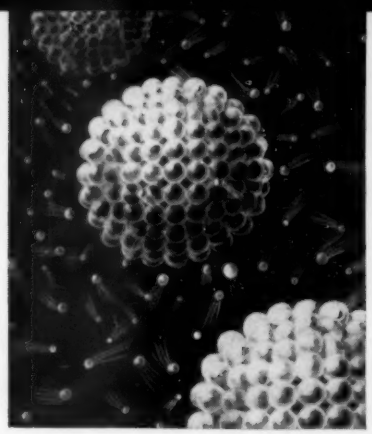
Radiographic examination, pipe welds ..... Industrial X-Ray, Inc

Corrugated siding and louvers ..... W Biddle Walker Co

Filtered-air system, control room ..... Spitzley-Retemier Sheet Metal Co

Engineers and constructors ..... **The Kuljian Corporation**

NUCLEAR-ENERGY STUDY COURSE: NUMBER 3



Some heavy elements change themselves steadily and spontaneously into atoms of lighter weight. The nuclear-power engineer of the future must understand how . . .

Radioactivity signals nuclear changes

By **HENRY C SCHWENK**, *Henry Pratt Company*
and **ROBERT H SHANNON**, *United Engineers and Constructors Inc*

► THE 92 ELEMENTS found in nature exist in about 300 isotopic forms. About 40 of these isotopes are known to be unstable, and to change or disintegrate spontaneously. These are *radioactive isotopes* and the phenomenon is called *radioactive disintegration* or *radioactive decay*.

The instability that leads to radioactivity occurs in the natural isotopes of the elements with highest atomic weight. These elements have the most complicated nuclear structures. The complex relationships between the particles of these heavy nuclei lead to the spontaneous emission of radiation with consequent diminution of the isotope.

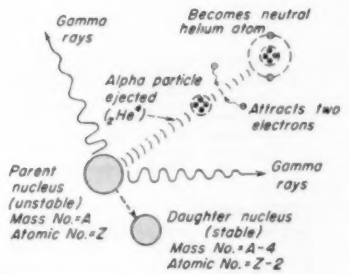
The radiation really is an expulsion of charged particles from the nucleus of the atom at a definite rate. This leaves behind an atom lighter than before, possessing physical and chemical properties different from those of the original parent element. This radiation is emitted by the element without the addition of any energy.

Only the elements from polonium ($Z = 84$) upward exist in these unstable radioactive forms in nature. The elements thallium (81), lead (82) and bismuth (83) occur largely in stable form with some radioactive isotopes present in nature, see table on p 94.

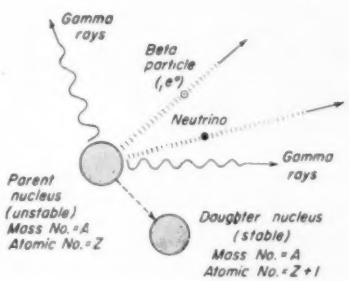
The elements below thallium are stable as found in nature, although radioactive isotopes of all the elements have been produced artificially by various nuclear reactions. Production of artificial radioactive isotopes has made important contributions to a variety of scientific fields—a subject we will discuss later.

Radiation particles. Whether an element is naturally radioactive or an unstable isotope (produced by various transmutation and disintegration processes) the radiations emitted are of three basic types: (1) alpha particles (2) beta particles and (3) gamma rays.

Alpha particles (a or $He{+}{+}$) are emitted from nuclei of radioactive isotopes at high velocity (2×10^9 cm per sec—about 1/10th speed of light) carrying a positive charge. The charge consists of two positive units and since the mass is four times that of a hydrogen atom, the alpha particle must be a helium nucleus (mass number of 4 consisting of 2 protons and 2 neutrons). The massiveness of these particles, plus their velocity gives them the ability to produce marked ionization* of any gas through which they pass. As the particle moves away from the parent isotope (ionizing the air through which it passes) its energy and speed decrease to the point where eventually two electrons are attracted to the particle and convert it into a neutral helium atom, Fig. 1. Size of alpha particle limits its travel in air to a few inches. Actual range depends on the medium through which the particle moves. Alpha particles do not have a very great penetrating power compared to other types of radiation. Their passage may be blocked by any shielding, a few sheets of paper or the human skin being unpenetrable.



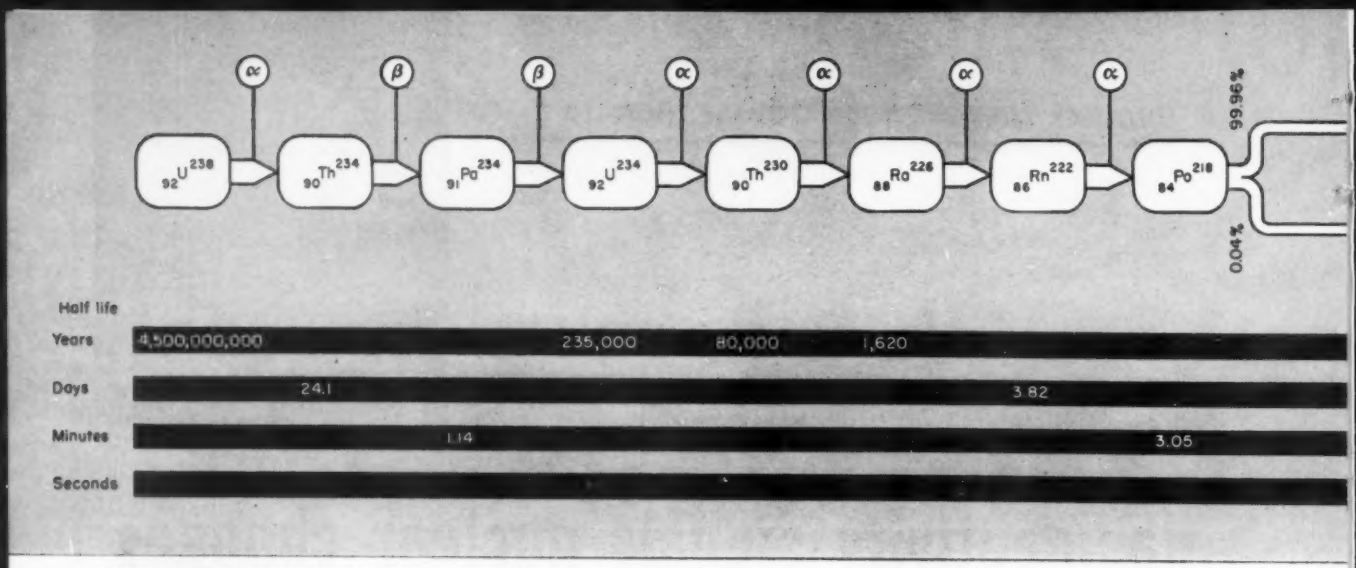
1 Alpha particle shooting out of nucleus quickly becomes a helium atom



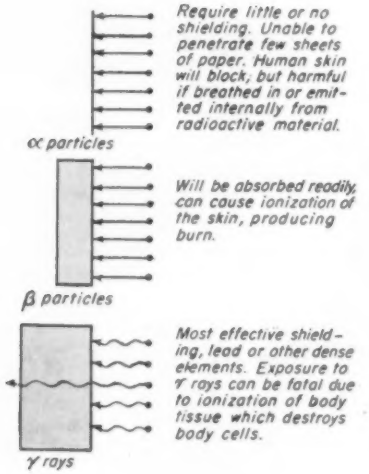
2 Beta particle zooms out of nucleus at a speed close to that of light, is equivalent to an electron

Beta particles (β or $_{-1}e^0$) are emitted from the nuclei of radioactive isotopes at a very high velocity (approaching the speed of light). The electrical charge (single, negative) and mass of a beta particle are same as those of an elec-

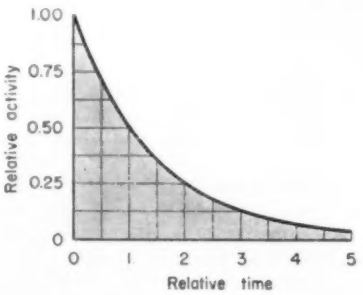
*Ionization of a gas is the breaking up of its molecules into positively- and negatively-charged fragments (ions) giving the gas the ability to conduct electricity. This phenomenon is used in most radiation-detection instruments.



RADIOACTIVE URANIUM SERIES runs for fantastically long periods and brief spurts of disintegration through 18 elements and


Require little or no shielding. Unable to penetrate few sheets of paper. Human skin will block, but harmful if breathed in or emitted internally from radioactive material.
α particles
Will be absorbed readily, can cause ionization of the skin, producing burn.
β particles
Most effective shielding, lead or other dense elements. Exposure to γ rays can be fatal due to ionization of body tissue which destroys body cells.
γ rays

3 Radiation particles have different penetrating powers through shielding



4 Rate of decay of radioactive elements is measured by half-life time

Elements that are naturally radioactive

Atomic No.	Symbol	Element
81	Tl	Thallium
82	Pb	Lead
83	Bi	Bismuth
84	Po	Polonium
85	At	Astatine
86	Rn	Radon
87	Fr	Francium
88	Ra	Radium
89	Ac	Actinium
90	Th	Thorium
91	Pa	Protactinium
92	U	Uranium

tron. They are, therefore, high-speed electrons ejected from the nucleus during the disintegration process. Beta particles are much more penetrating than alpha particles, requiring considerably more shielding. The range of a beta particle might be a few feet, considerably more than the inches an alpha particle will travel. The fact that a beta particle is charged limits its travel to the short range. Lack of mass makes beta particles weak ionizers of any gas through which they pass.

Gamma rays (γ). When an alpha or beta particle is expelled from a radioactive nucleus the remaining daughter nucleus is still in an excited state and emits this excess energy in the form of gamma radiation some 10^{-15} sec later to reach ground energy state.

Gamma rays are a form of electromagnetic radiation similar to X rays or light rays, but of shorter wave length and possessing a very high energy level.* These rays are a highly penetrating form of radiation. Passage through considerable thickness of lead or other dense materials is required before the rays lose enough energy to be considered harmless, or to be absorbed.

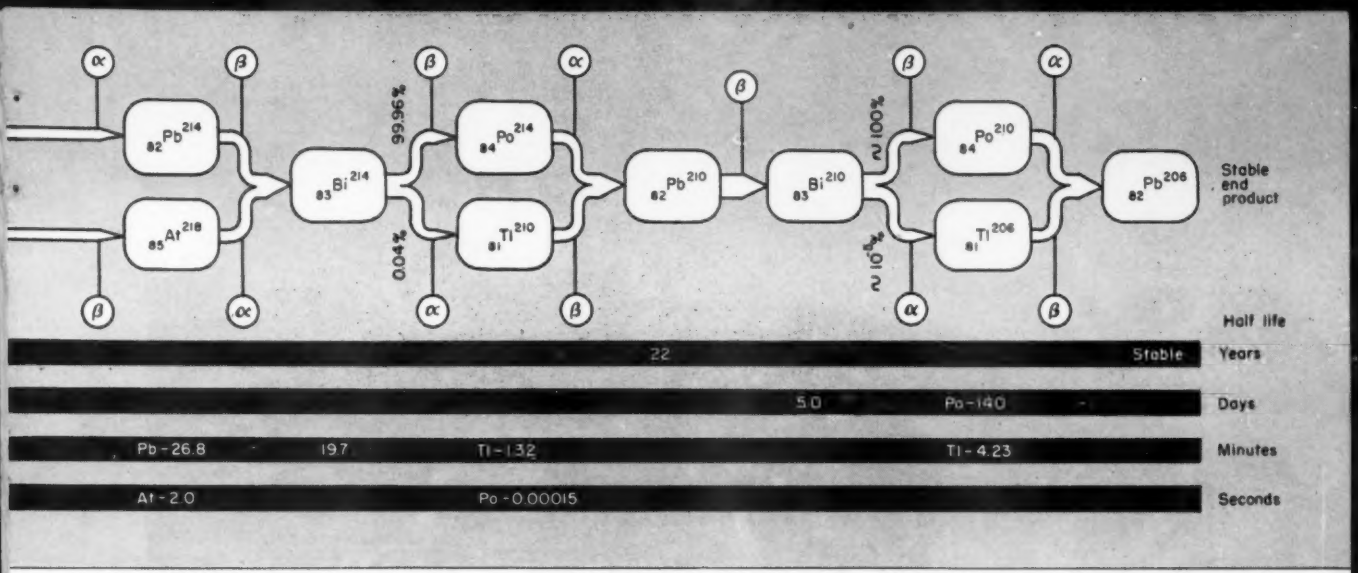
Radioactive change. In its radioactive decay, an unstable nucleus seeks to attain stability. This decay might go through a number of steps, with the products of decay (daughter nucleus) being unstable and in turn expelling an alpha or beta particle and so on, until a stable nucleus is formed. The daughter nucleus in each case is lighter than before and possesses a different set of physical and chemical properties from the parent element.

As outlined before, an alpha particle $= a = He$ nucleus $= {}_2He^4$, with an atomic number $(Z) = 2$ and a mass number $(A) = 4$. Thus in any disintegration in which an alpha particle is emitted, the atomic weight of the daughter element will have an atomic number two less and a mass number four less than the parent element. For example:

$$_{92}U^{238} \rightarrow {}_2He^4 + {}_{90}Th^{234}$$

Since radiation emits from the nucleus and free electrons are normally

*X rays originate from inner electron orbits; gamma rays are emitted from the nucleus.



isotopes before ending up as common, stable lead. Starting with U-238, the series emits total of 11 alpha, 9 beta radiations

not found in the nucleus, the origin of high-velocity beta particles requires clarification. There are no electrons as such in the nucleus. It is theorized that the electrons emitted as beta particles must result from the spontaneous conversion of a neutron into a proton and an electron. The electron is ejected while the proton remains in the nucleus —a process also accompanied by the release of another very small neutral particle called the neutrino.

Neutron → proton + electron + neutrino

The neutrino is very minute, even compared to the electron, Fig. 2. As it has no charge, it can pass through matter readily and is very difficult to detect. Thus the expulsion of a beta particle means that the nucleus has lost one neutron and gained one proton. Referring to Part 2, p 97, August 1954, POWER, you recall that the mass number is the sum of protons and neutrons in the nucleus. Therefore, conversion of a neutron to a proton makes no difference in the mass number. The additional proton in the nucleus does, however, increase the atomic number by one. Using the symbols of Part 2:

A = mass number (approx atomic weight)
Z = atomic number (number of protons in the nucleus)
A–Z = number of neutrons in nucleus

Thus for a nucleus containing Z protons and A–Z neutrons, the expulsion of a beta particle means the nucleus will have $Z + 1$ protons and $(A–Z)–1$ neutrons. The mass number that represents the number of protons and neutrons remains unchanged $(A–Z–1) + (Z + 1)$, while the atomic number increases by the value of one.

$$_{90}Th^{234} \rightarrow {}_{1}e^{0} + {}_{91}Pa^{234}$$

In other words, an isotopic form of another element with the same mass number as the parent element is formed.

Rate of radioactive decay. The disintegration of a radioactive element proceeds spontaneously at a definite rate. In a given radioactive element, there is a definite probability for the decay of each nucleus present at any moment. It is not known which individual atoms will disintegrate, only that in a given time a definite percentage will. This probability of decay is a specific property of any given radioactive element.

Decay proceeds exponentially with time: the rate of disintegration is proportional to the number of atoms present at that time. As the number of atoms present changes because of decay, the rate of decay also changes.

A constant generally used to measure the decay rate is called the *half life* of the radioactive element. It is the time needed for any given amount of radioactive substance to decay to half of its initial value. Half lives range from 10^{-6} seconds for the most unstable materials to 10^{10} years for those only slightly unstable. The exponential decay curve for a radioactive material appears as in Fig. 4. A given amount of material decays to half its original value in 1 sec, and to half (¼ of original value) of that value in another second, and to half (⅛ of original value) of that value in another second, and so on. Thus the half life is a constant time value, during which any given amount of a radioactive substance loses one half of its activity.

Radioactive series. The 40 or so different radioactive elements found in nature fall into three distinct families known as the (1) thorium series (2) uranium series and (3) actinium series. The thorium series starts from thorium, the uranium series from one isotope, U-238, and the actinium series from another isotope, U-235. The final product of each series, after a series of alpha and beta particle emissions is a stable isotope of lead.

Chart, above, shows the uranium series starting with long-lived U-238, primary isotope of natural uranium (99.3%). The parent of U-238 had a shorter life and no longer exists in nature in any detectable amounts. Chart gives the half lives of each step and the atomic number and mass number of each isotope formed. Branched disintegration occurs several times in the chain with an isotope decaying two ways. A certain percentage decay by alpha emission, the rest by beta emission, always in the same definite proportion. After a subsequent disintegration both daughter isotopes yield the same new common daughter.

This series has enabled scientists to estimate the age of uranium deposits and the earth's age. By determining the percentage of stable lead in a uranium deposit, aged enough for equilibrium to be established, it is a simple matter to determine the age of the deposit if the half lives are known. With the half life of uranium 4.5 billion years and the earth 2.5 billion years old, we can see the series is still undergoing disintegration.

NEW TURBINE BUILDING, *left,* and general office building with locker rooms, washrooms, *above, right,* make extensive use of glass block for daylight illumination. Louvered openings in turbine-room wall supply air to ventilation system. General office and control room are air-conditioned year round. Plant "hot spots" are equipped with ventilating or exhaust systems

Philadelphia Electric Company expands system capacity by installing its first two reheat units at Delaware Station. Steam generators with pressurized radiant furnaces use gas recirculation for superheat control. Studies showed . . .

Twin stacks improve flue-gas ducting

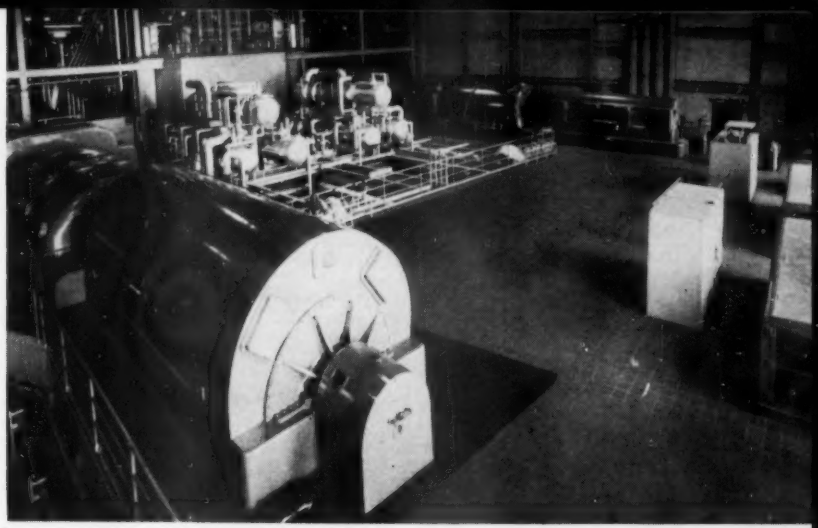
By **STANLEY MOYER**
Assistant Mechanical Engineer
Philadelphia Electric Company

► UNIT No. 8 at Delaware Station went into service in April and No. 7 in August 1953. These 125,000-kw 1800-psig 1000/1000-F units have 3600-rpm tandem-compound 3-cylinder triple-exhaust turbines. At 15-psig hydrogen pressure the separately excited generators can develop 169,118 kva.

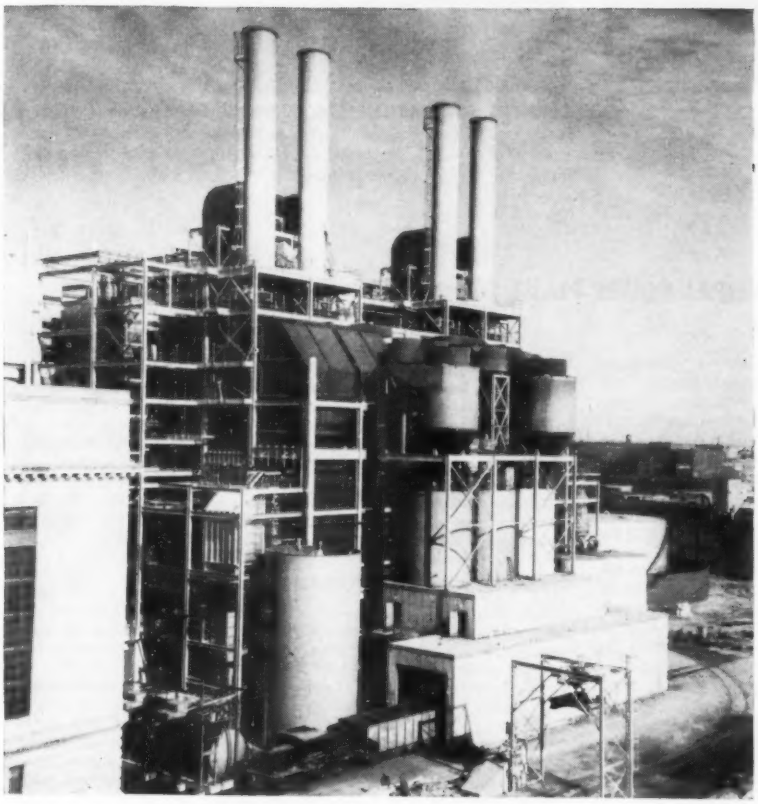
Semioutdoor boilers have all equipment other than the burners exposed to the weather. Corrugated-metal siding and roofing with an aluminum finish enclose certain areas around the boiler and coal-handling system.

Radiant furnaces are the pressurized type. Dampers and gas recirculation, from the economizer outlet at 600 F back to the furnace, exert primary superheat control. Spray-water injection aids when needed.

Two forced-draft blowers normally pressurize the furnace. To insure

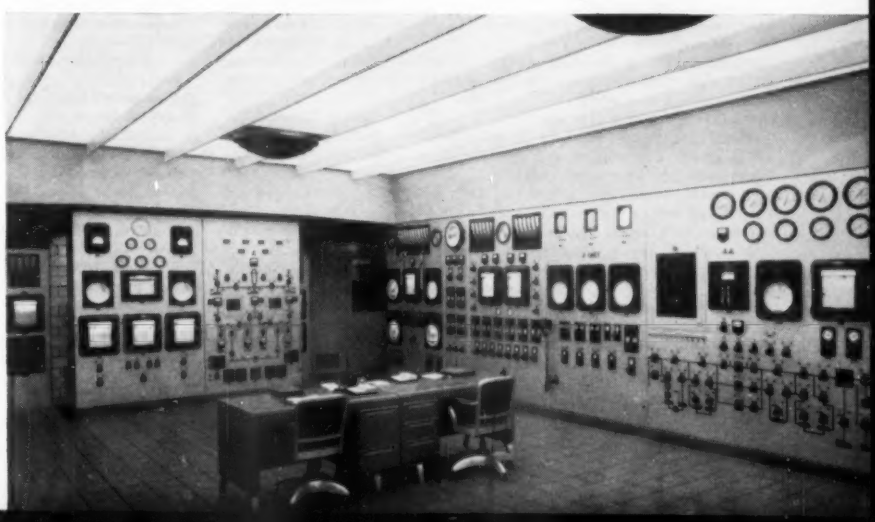


TURBINE-ROOM FLOOR of new extension holds three horizontal high-pressure heaters of each unit—No. 7, *background*. No. 8, *left*, between turbines. 125,000-kw units run at 1800 psig and 1000 F at throttle, with 1000-F reheat



SEMIOUTDOOR BOILERS—No. 7, *left*—are each rated at 875,000 lb per hr. Dust-collecting equipment stands in foreground just below twin stacks, includes mechanical collector and electrical precipitator for high efficiency

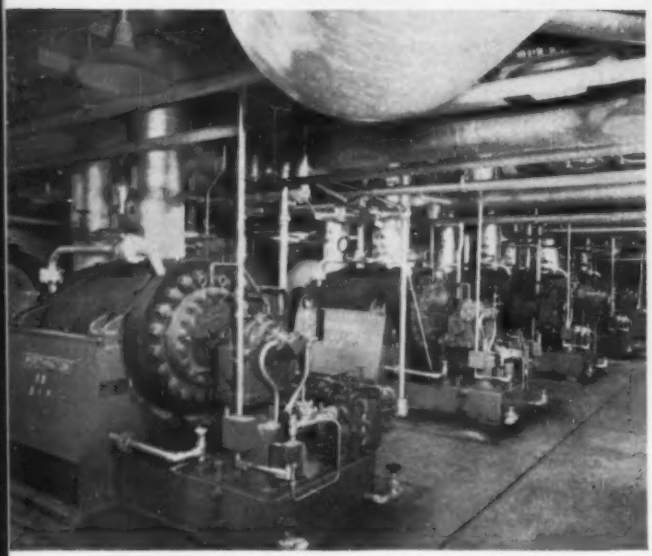
CENTRAL CONTROL ROOM supervises boiler, turbine and generator for both units. Boiler and heat-balance boards for No. 7 stand at right. Electrical board stands left background, centrally between No 7 and 8 boards ***Turn page***



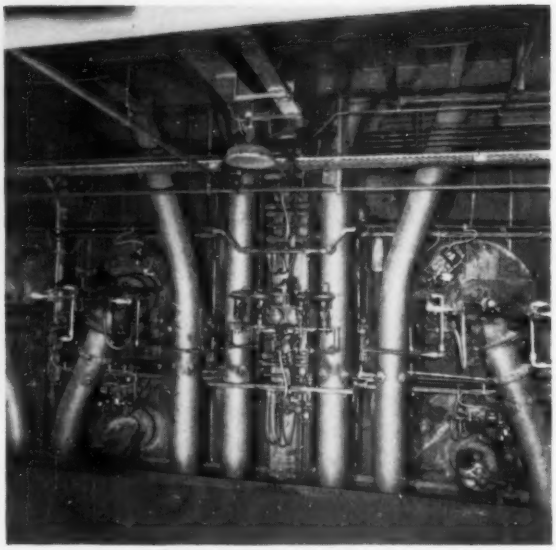
greater reliability, each unit has one induced-draft fan so routine maintenance can be done while the furnace runs under suction.

Combination mechanical collector and electric precipitator removes flyash from stack gas. Arrangement with tubular air heater is shown in diagram, page 100. An over-all efficiency of about 96% is expected; stack emission will not

(*Text continued on page* 100)



FIVE BOILER FEED PUMPS serve two units. Center pump can serve either unit as a spare; flanking pairs serve only one unit. 500,000-lb-per-hr pumps driven at constant speed have boiler feedwater-regulating valves at their discharge



BURNERS FOR PRESSURIZED FURNACE handle either pulverized coal or oil. Four mills supply burners on each boiler with total of 82,000 lb per hr of 13,700-Btu-per-lb coal with grindability of 55%. Boiler efficiency equals 91.3%

PRINCIPAL POWER-PLANT EQUIPMENT

POWER-GENERATING EQUIPMENT:

Turbine-generator unit No. 7 .....General Electric Co

Turbine-generator unit No. 8 .....Westinghouse Electric Corp
Ratings of each unit: *Turbine*—125,000 kw, 3600 rpm, tandem-compound, reheat-condensing, three cylinder, triple exhaust, 1800 psig, 1000/1000 F. *Generator*—125,000 kw, 0.85 pf, 147,059 kva with 0.5-psig H_2 press, 13,800 volts, 2-circuit winding, separately excited

Exciter m-g sets, 2 .....Westinghouse Electric Corp
350 kw, 375 v, 1185 rpm, one spare for either main unit

Exciter m-g set, 1, 400 kw, 375 volt, 1200 rpm.....General Electric Co

Condensers, 2 .....C H Wheeler Mfg Co
Single pass, 550,000 lb steam per hr at 1-in.-Hg press, 55-F cooling water, deaerating hotwell, 60,000 sq ft, 10,250 ¾ in. 18-BWG tubes

Circulating pumps, 2, one spare pump rotor.....C H Wheeler Mfg Co
Vertical, single inlet, 85,000 gpm, 25-ft tot. hd, 700-hp motor, 250 rpm

Steam jet air ejectors, 2 .....C H Wheeler Mfg Co

Dry vacuum pumps, motor driven, 2 .....Ingersoll-Rand Co

FEEDWATER EQUIPMENT:

Condensate pumps, 4, 500-hp motor, 1150 rpm.....Worthington Corp
Vert centrifugal, 1,000,000 lb per hr each, 315-psi max shutoff press

Low-pressure heater No. 1, two .....The Lummus Co
900,000 lb per hr feedwater, arsenical-admiralty horizontal U tubes, 4005 sq ft, 802 5/8-in. 18-BWG tubes, 275-psi tube press., 3.7-psia shell

Low-pressure heater No. 2, two .....The Lummus Co
900,000 lb per hr feedwater, arsenical-admiralty horizontal U tubes, 3215 sq ft, 500 5/8-in. 18-BWG tubes, 275-psi tube press, 12.8-psia shell

Low-pressure heater No. 3, two .....The Lummus Co
900,000 lb per hr feedwater, arsenical-admiralty horizontal U tubes, 5580 sq ft, drain-cooling section, 780 5/8-in. 18-BWG tubes, 275-psi tube press, 36-psia shell press.

Low-pressure heater No. 4, two .....The Lummus Co
900,000 lb per hr feedwater, arsenical-admiralty horizontal U tubes, 4470 sq ft, drain-cooling section, 666 ¾-in. 18-BWG tubes, 275-psi tube press., 80.5-psia shell press.

High-pressure heater No. 5, two .....The Lummus Co
900,000 lb per hr fw, monel tubes, desuperheating and drain-cooling sections, 4420 sq ft, 594 ¾-in. 17-BWG tubes, 2100-psi tube press., 176-psia shell press., horizontal U tubes

High-pressure heater No. 6, two .....The Lummus Co
900,000 lb per hr fw, monel tubes, desuperheating and drain-cooling sections, 4705 sq ft, 594 ¾-in. 17-BWG tubes, 2100-psi tube press., 392-psia shell press., horizontal, U tubes

High-pressure heater No. 7, two .....The Lummus Co
900,000 lb per hr fw, monel tubes, desuperheating and drain-cooling sections, 4900 sq ft, 600 ¾-in. 17-BWG tubes, 2100-psi tube press., 656-psia shell press., horizontal, U tubes

Drain cooler No. 1, two .....The Lummus Co
900,000 lb per hr fw, arsenical-admiralty tubes, 4005 sq ft, horizontal, 570 5/8-in. 18-BWG U tubes, 275-psi tube press.

Drain cooler No. 2, two .....The Lummus Co
900,000 lb per hr fw, arsenical-admiralty tubes, 2300 sq ft, horizontal, 450 5/8-in. 18-BWG U tubes, 275-psia tube press.

Boiler feed pumps, 5 .....Worthington Corp
Horizontal centrifugal, 2 per unit, one common to 2 units, capacity 500,000 lb per hr each, 1993-psi total head, 207-psi suction, one spare pump rotor assembly, 1750-hp motor, 3570-rpm direct drive

STEAM-GENERATING EQUIPMENT:

Boilers, 2 .....Babcock & Wilcox Co
875,000 lb per hr, 1875 psi, 1000/1000 F, pulverized coal or oil fired, 82,000 lb per hr of 13,700-Btu coal, 91.3% boiler efficiency, 46,660 cu ft furnace volume, 5389-sq-ft boiler, 11,585-sq-ft waterwalls, 43,450-sq-ft superheater, 20,300-sq-ft economizer, 4 ball mills per boiler, 25,400 lb coal per hr of 55% grindability

Air heaters, 2 .....Babcock & Wilcox Co
345,600 sq ft, tubular, 2 sections. Hot section: 2-in. OD steel tubes; cold section: 2-in. OD steel tubes ending in 3-in. OD aluminum tubes

Soot blowers, 52 .....Diamond Power Specialty Corp
20 retractable per unit, 6 wall blowers per unit

Closed-circuit television .....Diamond Power Specialty Corp
Boiler-water level and furnace observation

Forced-draft fans, 4.....Westinghouse Electric Corp, Sturtevant Div
130,000 cfm at 100 F, 36-in. static press., vane control, 1000-hp 4-kv motor drive

F-d-fan sound treatment .....Industrial Sound Control, Inc

Steam air heater, 4 .....Buffalo Forge Co

Induced-draft fan, 2 .....American Blower Corp
300,000-cfm gas at 250 F against static head of 18 in. H_2O, air-cooled bearings

F-d-fan motor drive, 1500 hp, 4 kv, 2 .....Elliott Co

Flyash collectors, 2 .....Western Precipitation Corp
Mechanical, 80% efficiency

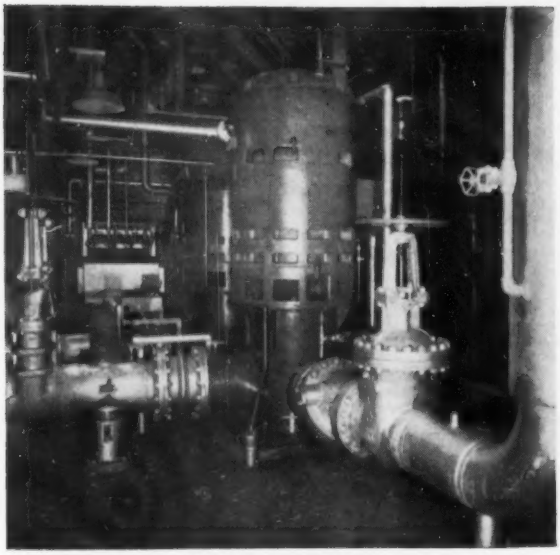
Flyash precipitators, 2 .....Research Corp
Electrical, 80% (in combination with mechanical, 96% effy)

Flyash pneumatic conveying system, 2 .....American Blower Corp

Bottom ash-conveying system, 1 .....Allen-Sherman-Hoff Co
Pneumatic, intermittent, steam jets

Rotary flyash unloaders, 4 .....Beaumont Birch Co

Rotary bottom ash unloaders, 2 .....Allen-Sherman-Hoff Co



TWO VERTICAL CONDENSATE PUMPS on each unit have rubber expansion joints on pump suctions. Each pump rated at 1,000,000 lb per hr can handle full-load flow alone. 500-hp motors drive pumps at 1150 rpm to produce 315 psig

COOLING-WATER INTAKE from river includes screening basin, condenser circulating-water pumps and river-water pumps with outdoor electrical controls. Structure at left houses the cooling-water chlorination equipment, controls Turn page

Delaware Station, Units 7 and 8, Philadelphia Electric Company

MISCELLANEOUS PUMPS:

High-pressure fuel-oil pumps, 2 ..... Ingersoll-Rand Co
Horizontal, centrifugal, 300-gpm bunker C, 3550 rpm, 1000-psi discharge, 300-psi suction, 250-hp motor drive
River-water pumps, 3 ..... Layne and Bowler, Inc
Fire pump, 1 ..... Worthington Corp
Condensate storage, 2 ..... Ingersoll-Rand Co
City water, 2 ..... Ingersoll-Rand Co
Gland-seal pump, 1 ..... Ingersoll-Rand Co
Chemical-solution pumps, 5 ..... Milton Roy Co
Hydrostatic-test pumps, 1 ..... Milton Roy Co
Demineralizing-makeup pumps, 2 ..... Layne and Bowler, Inc
Acid pumps, 2 ..... Maleson Co LaBour
Caustic pumps, 2 ..... Maleson Co LaBour
Sump pumps, 6 ..... Maleson Co LaBour
Sump pumps, 3 ..... Goulds Pumps
Sewage pumps, 2 ..... Chicago Pump Co
Boiler drain sump pumps, 2 ..... Layne and Bowler, Inc
Ignition-oil pumps, 2 ..... Sier Bath Gear & Pump Co, Inc
Ash-unloader pumps, 2 ..... Layne and Bowler, Inc
Fuel-oil pumps, 3 ..... DeLaval Steam Turbine Co

VALVES:

Motor-operated steel valves ..... Crane Co
Hand-operated steel gate and globe valves ..... Wm Powell Co
Piston and swing type steel check valves ..... R-P & C Valve Div, American Chain & Cable Co, Inc
Tilting-disk steel check valves ..... Chapman Valve Mfg Co
Butterfly valves and operators ..... Henry Pratt Co, Inc
600-, 1500-, 2500-psi steel globe ..... Manning, Maxwell & Moore, Inc
600-psi steel check valves ..... Crane Co
1500-psi steel check and gate valves ..... Henry Vogt Machine Co
1500- and 2500-psi alloy-steel globe valves ..... Edward Valves, Inc
Steel-bar stock valves, 16-in. cast-iron gate valves ..... R-P & C Valve Div, American Chain & Cable Co, Inc
Tilting-disk cast-iron check valves ..... Chapman Valve Mfg Co
All other cast-iron valves ..... Wm Powell Co
Blow-off valves ..... Yarnall-Waring Co
Automatic recirculating valves ..... Republic Flow Meters Co
Soot-blower sys press.-reducing valves ..... Republic Flow Meters Co
Aux-steam press.-reducing valves ..... Spence Engineering Co

MISCELLANEOUS:

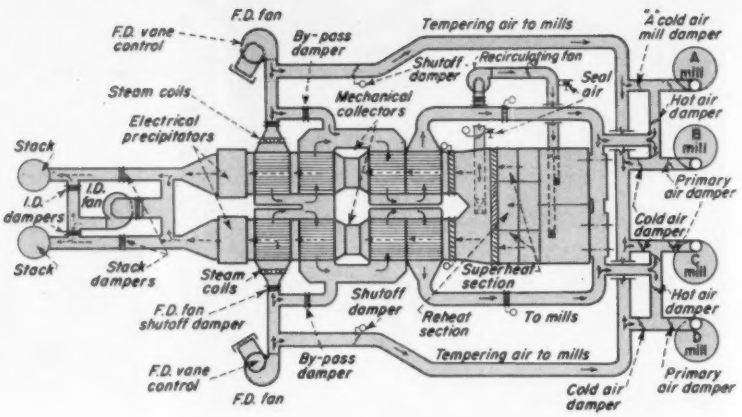
Turbine hall crane ..... Whiting Corp
Two trolleys, each with 75-ton main hoist and 15-ton aux hoist
Demineralizing equipment ..... Illinois Water Treatment Co
Elevators, boiler room, office ..... Haughton Elevator Co
Elevator, coal tower ..... Otis Elevator Co
Intake screens, 2 ..... Chain Belt Co
90,000 gpm normal flow, 122,000 gpm max, No. 12 W & M bronze wire with ¾-in. openings, 10 fpm normal speed, automatic operation by water-level drop across screen
Stacks (and ducts), 4 ..... Connery Construction Co
High-pressure piping ..... W K Mitchell Co, Inc
Low-pressure piping ..... Cornell and Underhill, Inc
Chlorinating equipment ..... Wallace & Tiernan Products, Inc

INSTRUMENTS AND CONTROLS:

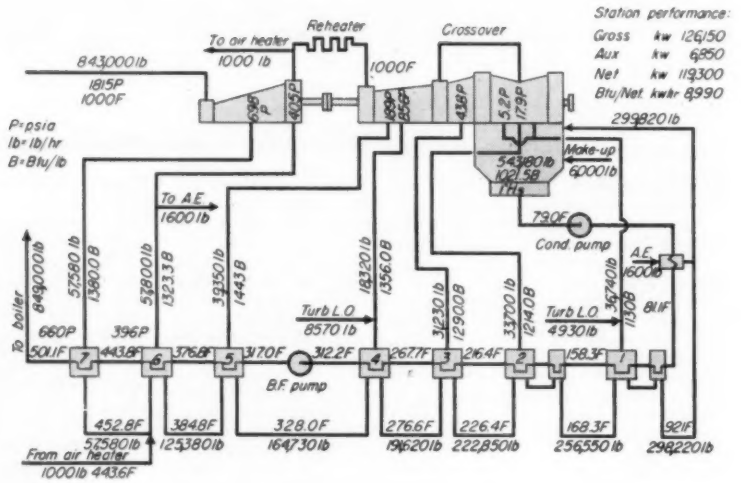
Instruments: Precision Thermometer & Instrument Co, The Bristol Co, Republic Flow Meters Co, Minneapolis-Honeywell Regulator Co, Hagan Corp, Leeds & Northrup Co, Bailey Meter Co, J L Lonergan Co, Clifford B Ives & Co, Maleson Co, Crosby Steam Gage & Valve Co
Station air compressor, 1 ..... Ingersoll-Rand Co
895 cfm free air, 100-psig, 2-stage horizontal duplex, water-cooled, 175-hp synchronous motor drive
Control air compressors, 2 ..... Ingersoll-Rand Co
95 cfm free air, 100-psig, 2-stage V type, air-cooled, 20-hp squirrel-cage induction motor drive
Aftercoolers ..... Ross Heater Div, Kewanee-Ross Corp
Combustion-control system ..... Hagan Corp
Oil-ignition control, Superheat and reheat control, Feedwater-level control ..... Bailey Meter Co
Condenser-hotwell level control, heater drainer valves and control. Climax Controls Div, Black, Sivalls & Bryson Inc
Boiler feed-pump recirculation control ..... Republic Flow Meters Co

COAL-HANDLING SYSTEM:

Coal handling ..... Link-Belt Co
Coal crushers, 3 ..... Pennsylvania Crusher Co
350-tons-per-hr run-of-mine coal, 200-hp motor drives
Barge unloading hoist ..... McKiernan-Terry Corp
400 tph free digging, 400-hp motor drive, 60-hp trolley motor
Magnetic pulleys, 3 ..... Stearns Magnetic, Inc
2 pulleys in coal tower, 1 for emergency system, 2 m-g sets, 15-hp motor, 7.5-kw generator each
Electronic coal scales, 2 ..... Trans-Weigh Co
Car shaker, 1 ..... Hewitt-Robins, Inc
Diesel-electric locomotive ..... Baldwin-Lima-Hamilton Corp
45 tons, two 165-hp Cummins engines



GAS-FLOW, AIR-FLOW DUCTING. Layout shows two forced-draft blowers per boiler. Induced-draft fan will be used only in routine maintenance procedures. Mechanical collector hooks up between sections of tubular air heater



DELAWARE NO. 7 HEAT BALANCE. Deaerates feedwater in main condenser hotwell, uses seven closed feedheaters. Five h-p heaters have integral desuperheating and drain-cooling sections; others separate drain coolers

exceed 0.25 lb flyash per 1000 lb gas.

Two 70-ft-high 9-ft OD steel stacks per boiler are an unusual feature. Duct arrangement dictated this design with a resulting better distribution of gas loading and a saving in construction cost.

Main condensers have each one vertical mixed-flow single-stage circulating pump. Driven by 700-hp shielded drip-proof motors they deliver 85,000 gpm against 25-ft head. These pumps are cross connected and valved so each pump supplies water to either its own unit or both condensers. With this arrangement either circulating pump can be used with the "on stream" condenser while the other unit is shut down for inspection and maintenance.

Each boiler has two individual feedwater pumps, a fifth pump acts as a spare for either boiler. Starting the latter pump from the heat-cycle panel (in the control room) of the unit on which it will be used also starts a sequence of valve operation automatically isolating the pump from the other unit's cycle. This starting sequence also sectionalizes the automatic feedwater recirculation necessary for protecting the pump. In addition the correct air loading to the feedwater regulating valve is selected.

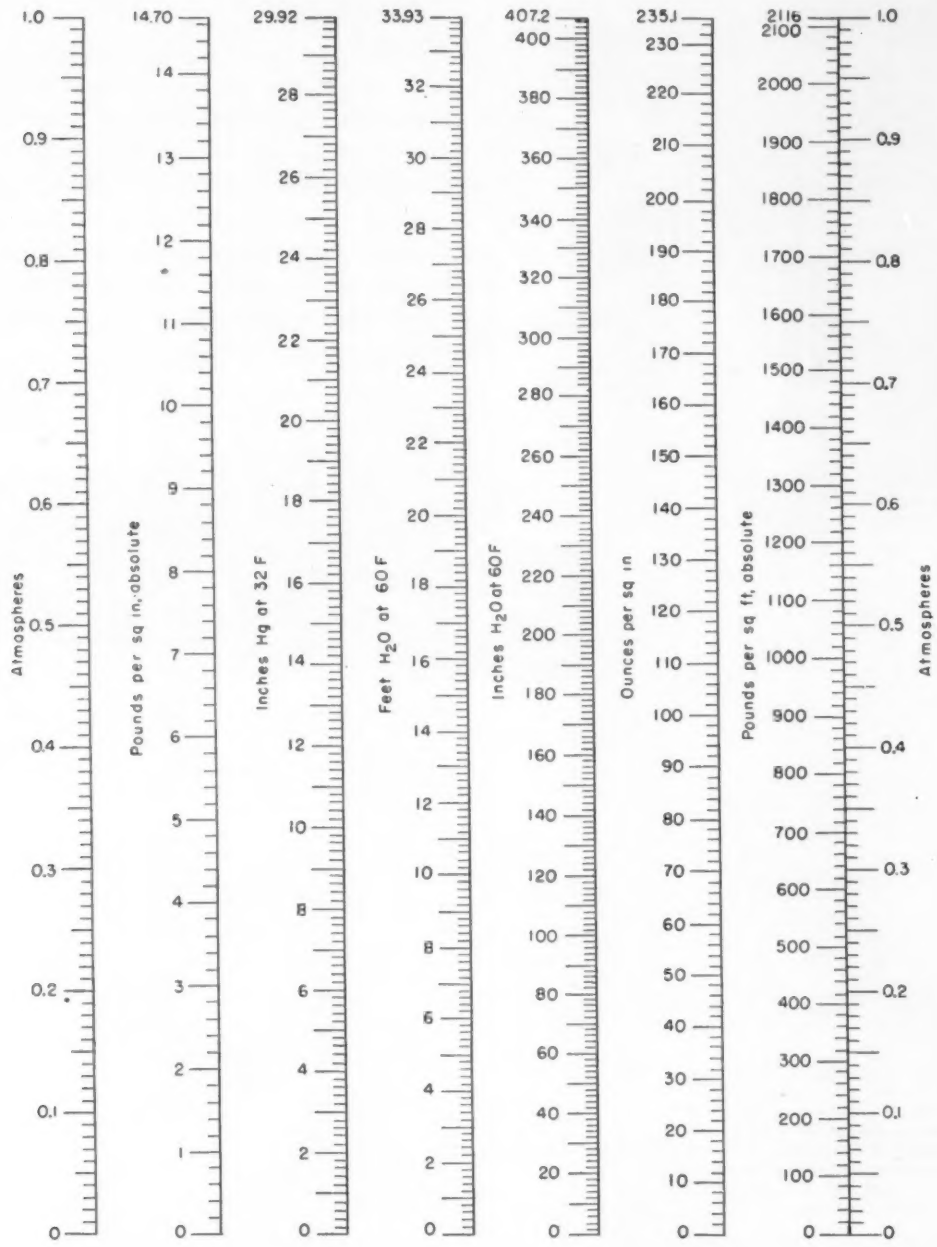
Regulating valves, at the discharge of each pump, control feedwater flow. This subjects the high-pressure heaters and piping to considerably lower pressure than if the valves were at the boiler-drum inlets.

Treatment for Philadelphia city water used as makeup consists of passing it through a mixed-bed demineralizer. Sulfuric acid and sodium hydroxide are the regenerating agents. Estimates indicate this treatment provides best makeup at lowest over-all cost.

To keep down the cost of high-temperature piping systems the arrangement is as direct and simple as space and allowable reactions on the turbine would permit.

Power's DATA SHEET

No. 267



Handy pressure-conversion chart

► PRESSURES EXERTED by fluids may be measured in many different units. These scales show the relation between seven of them. To use: (1) Find known pressure on one scale. (2) Lay straightedge on the point. (3) Make sure edge is horizontal by getting equal readings on outer atmosphere scales. (4) Read pressure in units wanted.

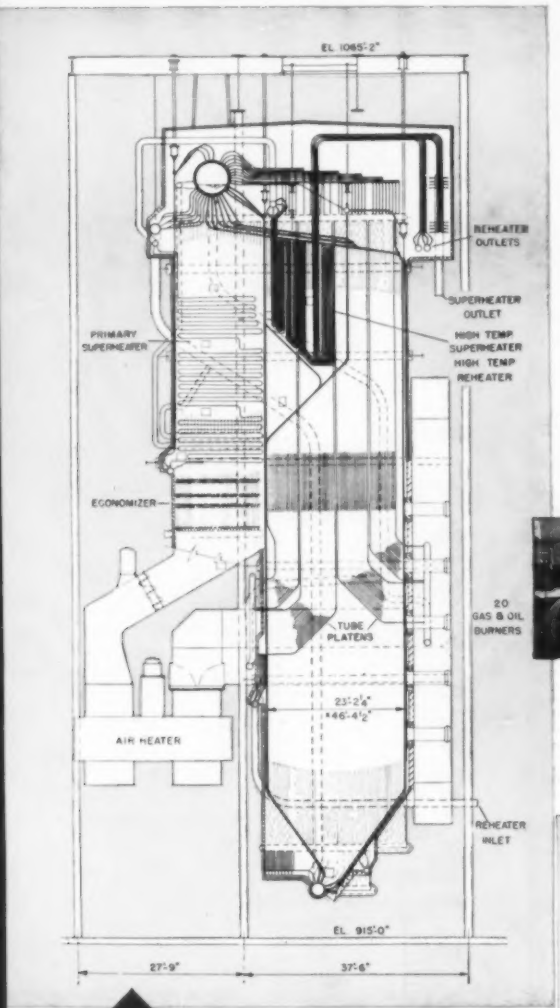
Example: Convert 12 inches Hg absolute to other units. Lay straightedge across 12 on third scale. Read 0.401 atmospheres on both side scales. Then find 5.89 psia, 13.6 ft water, 163.2 in. water, 94.3 oz per sq in, 849 psf abs.

For other ranges multiply all scales by 0.1, 10, 100, etc.

—Suggested by S D Distelhorst, Reading, Pa.

© POWER

Join the SWING to RILEY

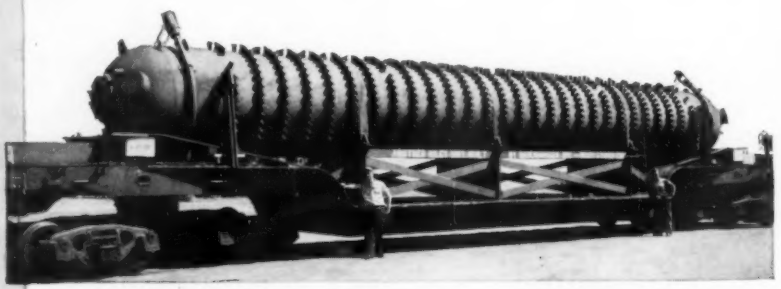


Los Angeles Department of Water & Power—Valley Steam Plant. Two 1,200,000 lbs./hr. 1850 psig. 1000F-1000F reheat. Fired by gas & oil. Riley Single Header Hopper for future conversion to Pulverized Coal. Temperature control by differential firing in divided furnaces.

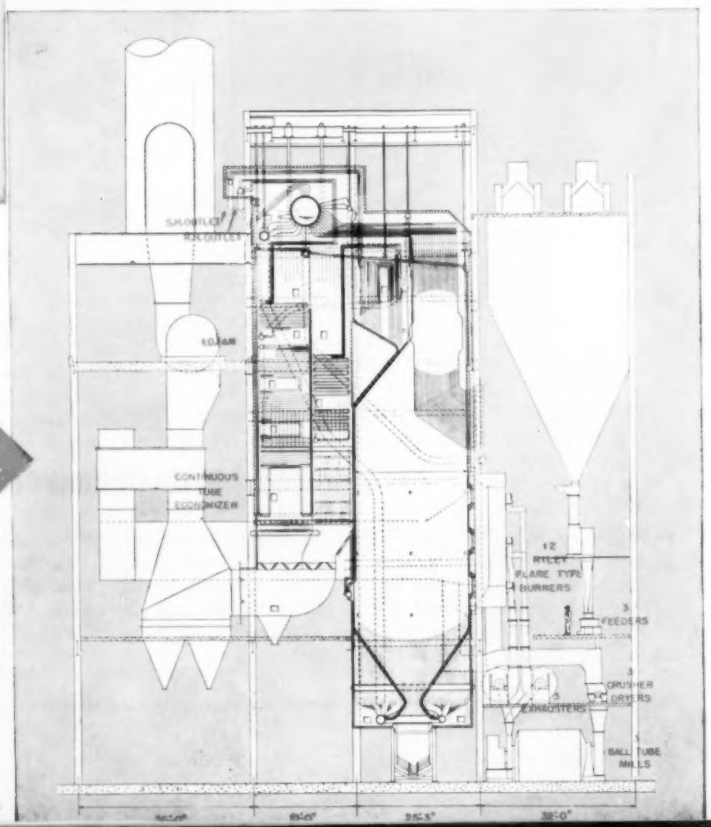
Public Service Co. of Indiana, Inc. Wabash River Station. 805,000 lbs./hr. 2075 psig design, 1005F-1005F reheat. Fired by 12 Riley Flare Type Burners, 3 Riley Pulverizers. Sargent & Lundy, Engineers.

A survey of your Power Plant by a consulting engineer will possibly show ways of making surprisingly large savings in your power costs.

This acceptance of Riley Reheat Units by the public utilities — this marked swing to Riley has been brought about by the outstanding design characteristics of Riley reheat units — low furnace exit temperatures through the use of radiant surface preventing objectionable slag formation; wide load range with stable ignition with damper or combination of damper and spray control; high yearly net efficiency, dependability and continuity of operation.

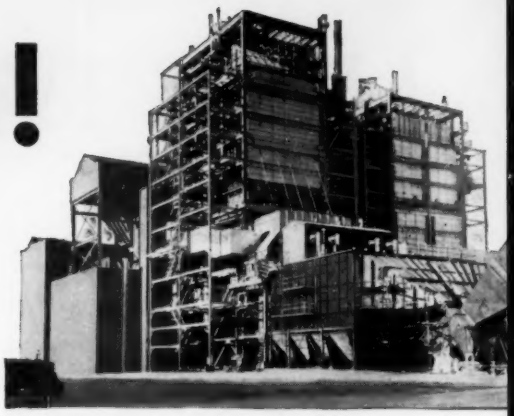


Riley designs, fabricates and erects the complete steam generating unit. Here you see the huge steam drum weighing 127 tons, 60'-0" long, 66" I.D. with 5-3/32" thick steel walls recently fabricated by Riley for one of two Riley reheat units at Los Angeles Water & Power Department's new Valley Steam Plant.

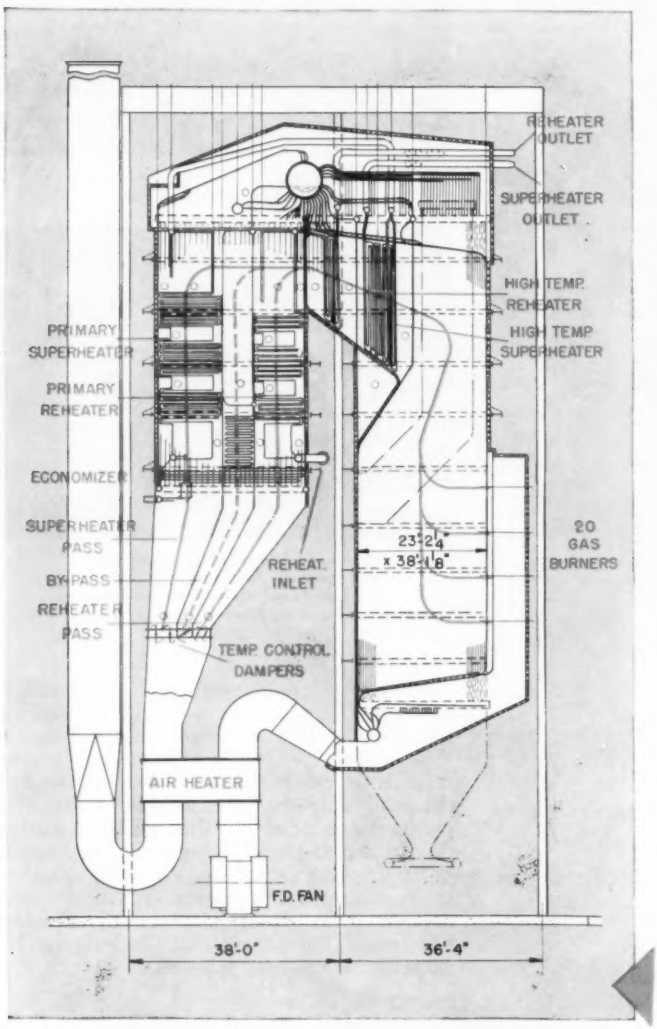


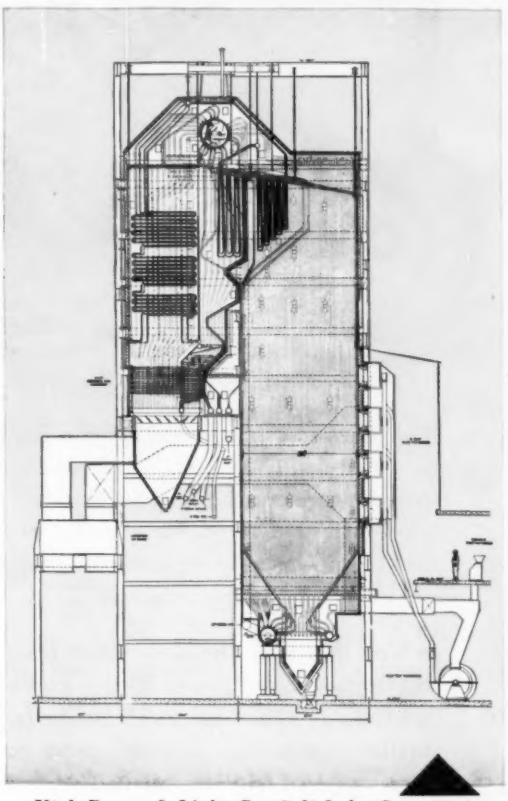
REHEAT UNITS!

a large percentage of all reheat units purchased by public utilities during 1953 were Riley units.



Completely outdoor construction is a feature of the two Riley units at Utah Power & Light Company — Gadsby Station





Utah Power & Light Co., Salt Lake City, Utah
Gadsby Station—575,000 lbs./hr. 1700 psig
1000F-1000F reheat. Riley "50" Pulverizers.
Bechtel Corporation Engineers

Louisiana Power & Light Co.—Nine Mile Point Station
1,000,000 lbs./hr. 1725 psig. 1000F-1000F reheat
Fired by gas & oil. Ebasco Services, Engineers

RILEY *Stoker Corporation*

WORCESTER, MASSACHUSETTS

Boston Atlanta New York St. Louis Philadelphia Kansas City Buffalo St. Paul Washington Tulsa Pittsburgh Houston Cleveland Denver Detroit Salt Lake City Chicago Los Angeles Cincinnati San Francisco Charlotte Portland New Orleans Seattle

COMPLETE STEAM GENERATING UNITS

AND FUEL BURNING EQUIPMENT FOR PUBLIC UTILITIES, INDUSTRIAL POWER AND HEATING PLANTS

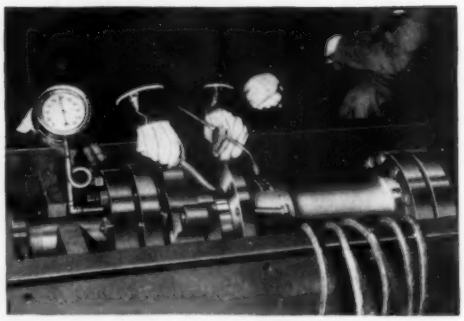
ADSCO EXPANSION JOINTS...

UNPACKED AT FULL PRESSURE

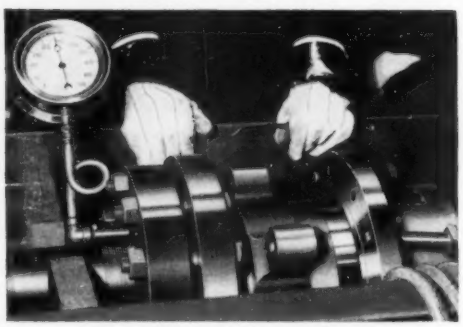
▶ ADSCO piston-ring expansion joints can be serviced . . . in fact, unpacked and repacked . . . under full line pressure. There is no interruption of service, no down-time for repacking, because the job is done under normal working conditions.

▶ Yet this isn't the only great feature of this high-quality joint. Slip is completely guided . . . split external guide permits smaller manholes . . . limit stops prevent over-travel of slip . . . polished surface cannot be scored because slip is in contact with packing only . . . misalignment is prevented by both internal and external guiding. ADSCO piston-ring expansion joints are available in a full range of sizes, with 4", 8", or 12" traverse per slip, for pressures to 400 psi and greater and for temperatures to 800F and higher. Call an ADSCO representative or write for Bulletin 35-15H.

. . . and here's proof



Last strand of packing being withdrawn from stuffing box.



Close-up photograph shows all packing removed. With steam at 240 lbs. pressure and with 300° superheat there is no trace of steam in the empty stuffing box.

With periodic adjustments of the gland, it may never be necessary to repack the stuffing box in an ADSCO piston-ring expansion joint. However, lack of maintenance may make it necessary at some time to do so and the job is easy with this ADSCO joint. The piston rings hold the line pressure during the unpacking and repacking operation. With the vent valve open, the vent chamber is at atmospheric pressure and, under this condition, no steam can enter the stuffing box space. Thus complete repacking can be done under full line pressure.

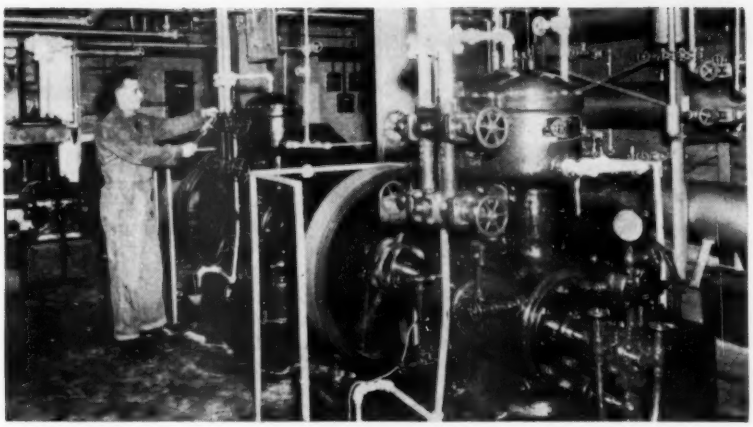
ADSCO ENGINEERED PRODUCTS

EXPANSION JOINTS
HEAT EXCHANGERS
STEAM TRAPS
STRAINERS
SEPARATORS
METERS

AMERICAN DISTRICT STEAM COMPANY, INC.

GENERAL OFFICES
NORTH TONAWANDA, NEW YORK
PLANTS: NORTH TONAWANDA, N. Y., AND RICHMOND, CALIF.

How to bone up for...



refrigeration operator's license

By WESLEY D TURNER, *instructor*

Suppose your city passes a refrigeration code that calls for licensed operators. Will you be able to pass the test? Here is what you must know to pass the New York City exams

► "IF YOU CAN PASS the New York City refrigeration exams, you can pass any city's exams" is a common saying around the country. I don't know if this statement is true—but I do know that our license is respected by all cities and states I've been in. Learning about our code and license requirements may help you prepare for an examination, write a code for your city, or set up a training course as I have done in New York City.

Kinds of license. We used to have two licenses: *limited* and *unlimited*. Limited license was naturally the simplest. It permitted holder to operate refrigerating machinery up to 10-tons capacity. Because the license was so limited, examination was an oral test, with questions based on plant that operator was in charge of. Recently this

Cycle is developed . . .

and models are explained by Instructor Wes Turner

license was discontinued and now always an unlimited license is required.

Unlimited license is very much in demand. It allows holder to operate any plant in New York City. And there are about 1000 applicants a year.

Exams are conducted by the city under Civil Service twice a year, usually in April and October. To qualify, you must pass both a written and a practical test. Passing grade is 70%. Fee of $10 is charged for taking exam. If you pass, you pay another $5 for the license and $2 every year for renewal.

Since 1945, the written exam has consisted of about 70 questions. For applicants who pass, a practical exam is arranged, usually at a large city-owned plant. Here a monitor asks the applicant a number of questions and observes while he operates equipment. If applicant fails this first practical test, he has two more chances without having to take a written exam again.

Course. There are a number of prep schools, both public and private, in New York City. I organized my school and have been conducting classes for the preparation of these licenses since 1945. Hours are 7 to 9 pm, five nights a week and Saturday afternoons. It takes most applicants 80 to 100 hours over a 6-month period of class-room work to pass the exams. Most active months are September and October, then March and April, as Civil Service exams are given in the spring and fall of each year.

First 15 minutes of each lesson at my school is taken up by a multiple-choice test, filled out on mimeographed sheets I hand the students. Then follows an hour-and-a-half lecture on some new subject. I develop this subject on the blackboard and students copy information in their notebooks. Usually I have students participate by calling on them to answer questions as I develop the subject. The last 15 minutes of a 2-hour session is devoted to an oral quiz, based on lesson assignment at last session.

At each class I hand out eight to ten sheets of printed text for students to study. Now I'm compiling much of this information in a booklet to sell for $3 to applicants who cannot attend my classes. All information needed to pass test for a New York license is covered, along with suggested references in various textbooks that applicant must study.

Trainees are usually men already working in the refrigeration or some allied field. Most are mechanics although I do get office workers, bank clerks, etc, who feel there's a big future in air conditioning. Many trainees find they need a license to operate new air-conditioning equipment in their building. Some large firms, such as banks, stores and loft buildings, pay tuition of their employes. I also have day classes now for groups from chain stores and restaurants, attending on company time.

What to study. Ammonia and Freon-12 are two main refrigerants to study. Inspectors ask many questions about ammonia because if an operator can handle ammonia safely he is competent to handle Freon-12. Remember that a license entitles its holder to operate any plant in the city.

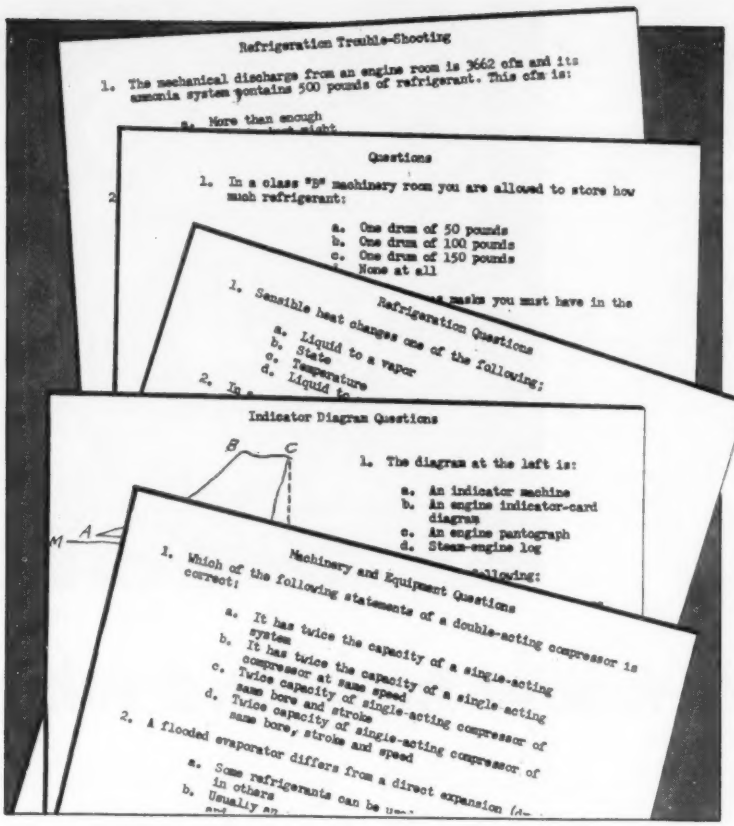
If you want to pass this course, I suggest you study characteristics of these two refrigerants in detail. You should also be familiar with Freon-22, methyl chloride, carbon dioxide, sulfur dioxide and Carrene.

Compression refrigeration is a popular subject. Learn design and construction of vertical and horizontal compressors; also, single-acting versus double-acting machines, various types of packing and seals, types of compressor valves, watercooled jackets and pistons and connecting rods.

Watercooled condensers: submerged, double-pipe, atmospheric, shell-and-coil, shell-and-tube—vertical and horizontal, and evaporative types. Also know how foul-gas purgers work.

Metering devices. First and simplest is the manual expansion valve. Rest are in this order: automatic expansion valve, thermostatic expansion valve, low-pressure side-float type, high-pressure side-float type and electric float-switch types.

Evaporators. Two groups are the direct cooling-coil and the flooded brine-coolers. Direct type is broken down


Refrigeration Trouble-Shooting
1. The mechanical discharge from an engine room is 3662 cfm and its ammonia system contains 500 pounds of refrigerant. This cfm is:
a. More than enough
Questions
1. In a class "B" machinery room you are allowed to store how much refrigerant:
a. One drum of 50 pounds
b. One drum of 100 pounds
c. One drum of 150 pounds
None at all
Refrigeration Questions
1. Sensible heat changes one of the following:
a. Liquid to a vapor
b. State
c. Temperature
d. Liquid to
Indicator Diagram Questions
B
C
A
1. The diagram at the left is:
a. An indicator machine
b. An engine indicator-card diagram
c. An engine pantograph
d. Steam-engine log
Machinery and Equipment Questions
1. Which of the following statements of a double-acting compressor is correct:
a. It has twice the capacity of a single-acting system
b. It has twice the capacity of a single acting compressor at same speed
c. Twice capacity of single-acting compressor of same bore and stroke
d. Twice capacity of single-acting compressor of same bore, stroke and speed
2. A flooded evaporator differs from a direct expansion
a. Some refrigerants can be
in others
b. Usually

Written examinations

Answering trouble-shooting questions like these keeps trainees on their toes. To get answers, they have to do a lot of reading that most operators won't usually do unless they must to pass exams

Code questions are the multi-choice type and cover every possible question that might be asked by the examiners

Basic questions cover about everything that an operator of refrigerating machinery needs to know to do a good job

Indicator diagrams are made by few operators, especially in smaller plants. Yet knowing how to make a card and diagnose it for possible compressor faults is something trainees can make good use of

Knowing the many types of machinery that a licensed operator runs into is assured with the help of these questions

into: plain coil type, finned type, and plate evaporators. Shell-and-tube and shell-and-coil coolers for indirect cooling include the flooded and the dry types.

Controls. Principle and purpose of automatic controls must be known. Study these: High-pressure valve, low-pressure type, backpressure or 2-temperature valves, pressure-regulated water valves, and electric solenoid valve.

Electric motors for refrigeration systems can need an extensive course. There are only a few questions asked. I suggest you understand basic design and application of repulsion-induction and capacitor motors having a good starting torque.

Large squirrel-cage and induction motors should be studied in detail. Most important questions usually asked in oral test are about large synchronous motors. These four motors are constant-speed, so you should also learn something about multispeed motors.

Engine indicators. Sometimes there are questions about compressor indicator diagrams. Know how to take them and how they help you do a better job. Diagnosing some of the more common compressor troubles from a diagram is important.

Salt brine. Two of the most popular salt brines asked about are sodium chloride and calcium chloride. Be sure to remember a few specific-gravity readings and corresponding freezing points. Read up on rust or corrosion inhibitors.

Lubricating oil. Study requirements for a good grade of refrigeration oil.

Steam-jet or vacuum refrigeration isn't too important a subject in this city's exam, but you should know cycle of system.

Absorption system. Questions are always asked about this system, especially about the cycle. Installations remaining in this city are ones that use steam for prime mover.

Code. Each exam has questions on New York City's Refrigeration Code. Code consists of excerpts from the Fire and Building Department Code. For a copy, write to Department of Combustibles, Room 1100, Municipal Building, New York 7, N. Y.

Engine-room layout from a safety angle: Some things to remember are where safety valves are to be vented to mechanical discharge of air from engine room as to tonnage and class of plant, fire-fighting systems, etc. Memorize all safety-valve sizes given in Code, and learn construction of fusible plug in detail. You must also know the two piping diagrams of Class-A and Class-B plants in back of the book.

With air-conditioning and quick-freezing plants springing up like mushrooms every day, this field has a bright future. City officials and operating men must prepare themselves to keep up with it.

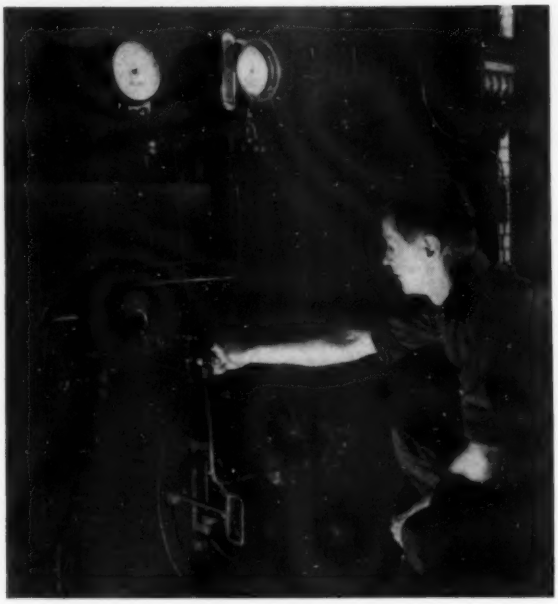
Background. What does it take to teach these courses? I worked as operator in cold-storage and frozen food plants, also designed freezers. During the war I sailed as refrigeration engineer on merchant ships.

After the war, I taught trade school for 2½ years, took teacher-training courses at Columbia University. Was a project engineer for an air-conditioning firm one year before starting my license preparation school.

EDITOR'S NOTE: For more information write to: Turner's Preparation School for New York City License Exams, 44 West 63rd St, New York 23, N. Y.

First of two articles on
FUEL-OIL ADDITIVES

By A J WEBER, *Kemsol Products*



For best results from your burners . . .

You need to know how and why

► AMONG ENGINEERS and plant operators there's a lot of talk about today's heavy oils—they're not what they used to be. Some of this is just old-fashioned griping, but we also find more than a grain of fact. Changes in refining methods aimed at improving yield and quality of gasoline and light fuel oils *have* made the byproduct heavy oils generally less easy to use than the straight-run residuals of years past.

Treatment of fuel oils thus gets more important every day. Yet it isn't well understood. It's important because *proper* use of the *right* additives can ease many heavy-fuel difficulties. It isn't well understood because heavy fuels and their sludges are complex compounds. Right here let's take a look at these oils and sludges, then in a later article we'll be ready to see how additives work and how to use them.

Residual fuel. Back in 1920, about 42% of each barrel of crude wound up as residual fuel. Now the percentage is down around 18 and will probably keep getting slowly smaller. This residual fuel is in pretty good shape when it leaves the refinery, but the changes that have pulled down the percentage of residual have also tended to alter its chemical makeup so it deteriorates more easily under normal storage and handling. Resulting sludges often foul storage tanks and lines, block strainers and preheaters, may cause burner fluctuations, smoky combustion, excessive soot, loss of capacity, higher fuel-oil consumption.

Sludge causes. Early refining consisted mainly of distillation, which merely separates the crude oil into its natural compounds. As shown in chart above, today's refineries increase yields of gasoline and light fuel oils by using high pressures and temperatures, with or without catalysts, to "crack" oil, breaking apart the molecules and recombining them.

Cracking effects. In cracking, and the associated recombining (*polymerizing*), heavy hydrocarbons are formed and concentrated, winding up in the residual. There is also some loss of hydrogen, so molecules tend to shift from the "saturated" to "unsaturated" form. Unsaturated compounds are likely to be less stable and may deteriorate to form sediment which, in the presence of water, will stabilize emulsions and sludges.

Sulfur. Any sulfur in the original crude tends to concentrate in the residual, and the heavier the residual the more sulfur in it. There's considerable evidence that sulfur compounds in fuel oil are sludge-forming—certainly the heavier sulfur compounds aren't soluble. For example, samples from typical storage tanks show sulfur content of sludge to be 2.61%, 1.22% and 2.01%. But corresponding sulfur percentages in fuel oil itself were only 0.76, 0.54, 0.35.

Viscosity. Today's economics dictate the production of resids that are more viscous than formerly. Blends of such resids with distillate cutter stock may be unstable because these different oils are not always mutually soluble or compatible with each other.

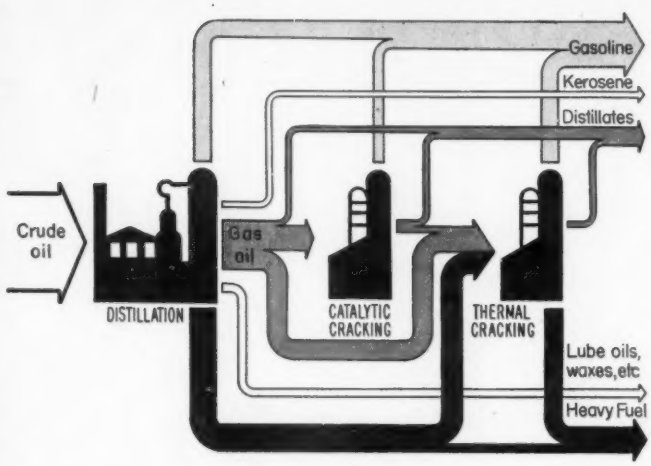
High temperatures and pressures in cracking some oils may produce heavy asphaltic compounds. If the residual isn't cut back, these remain suspended. But when it's thinned with distillate, the heavy materials sink slowly to the bottom of the tank. All these substances dropping out or separating from the oil, mixed with water and normal sediment, form a complex sludge.

Suction level. One factor frequently overlooked is height of suction above tank bottom—often 6 to 18 in. Oil below that level is never pumped. Water from condensation or contamination falls from top and sides of tank and, since it's heavier than oil, it sinks slowly, carrying down sediment and some of the floating compounds. If contents were taken from bottom of tank often, slow normal accumulation of sludge would be picked up as formed. That's why some use two suctions—high and low.

Formation of sludge is hastened and increased in storage by excessive heating, moisture, air pulled in by pumps.

Sludge composition. Sludge is thus a complex mixture of water and insolubles resulting from oxidation, de-

What kind of heavy fuel oil you get depends on refinery operations



REFINERY OPERATIONS average out like this. (Adapted from a paper by E F Miller and F L Nelson, Socony-Vacuum Labs)

Basic thing to remember about heavy fuel oil is that it's a residual product—what's left over after other, more valuable products have been taken out of the crude oil. While refinery operations are enormously complex, some idea of the major steps can be gained from the simplified chart, *left*.

First comes distillation—separation of the crude into its natural "fractions." To increase yield of gasoline and light fuel oil, most refineries charge some "straight-run" distillation products to a catalytic cracking unit, which breaks apart and rearranges the molecules. Then some "cat cracker" products, plus some gas oil and residual from distillation, are thermal cracked for more gasoline and light fuel oil.

Thus typical heavy fuel is likely to be thermal-cracked residual blended with straight-run residual and sometimes cut back with distillate fuel oil to reduce viscosity, etc.

Bear in mind that a modern refinery is highly flexible. Its operations can be adjusted within wide limits to yield products in accordance with demand. Residual varies with the crudes that are run and with the operating schedule. So, even from the same refinery, heavy-fuel characteristics will change, sometimes even from day to day.

sludge fouls up fuel-oil systems

composition and polymerization of the oil hydrocarbons. From one point of view, most of these compounds are OK—they will burn. But they give trouble because they're not miscible with oil.

Chemical composition is practically the same in all sludges—compounds of carbon and hydrogen with a little sulfur, oxygen and nitrogen. Variations in percentages of carbon, hydrogen, oxygen and sulfur, and how they're joined, cause differences in sludge appearance and characteristics.

Emulsions. Almost all sludges are emulsions, which complicates the problem of handling and treating resids. There are two types of emulsions: water-in-oil and oil-in-water.

A water-in-oil emulsion is one in which globules of water are surrounded by an external phase of oil—the oil or sludge is *outside* the water. This makes it easier to attack with oil-soluble treating agents, since it isn't necessary to penetrate the water, as would be the case if the water were outside, as in an oil-in-water emulsion. The type of emulsion determines the chemicals to be used and the results. Fortunately, most sludges and oil-tank emulsions are the water-in-oil type.

Emulsifier action. Emulsifiers are usually complex chemicals, some oil-soluble, some water-soluble, some soluble in both. They decrease the interfacial tension between water and sludge. Because the repelling force between water and sludge is lessened, these two materials get closer together. Emulsifiers also pick up some free water, making more emulsion.

Emulsifiers disperse water and sludge into the oil in a finely divided condition. When water is thus dispersed throughout the oil it doesn't adversely affect flame and combustion appreciably, although flame may show some sparking.

How much water can be picked up and emulsified by additives? The answer depends on two factors: type of additive and dosage. Most additives will handle water from condensation within the tank and the usual small quantity in the oil as delivered. If amount of water mixed with oil is large, treat with an additive having demulsifying properties, or heat the tank, allow to settle and draw off water. As a last resort, pump out, replace with good oil.

A demulsifier separates water from oil; water sinks to the bottom to be pumped out or drained.

Extraneous debris in sludge. Besides emulsions, other contaminants are present in typical sludges. While part of the water may enter into an emulsion, some may remain in a free separate state as a layer adjacent to the heavy sludge deposit. Another impurity is inorganic material. This slowly settles to the storage-tank bottom if oil remains in storage for any length of time.

There are also impurities such as tank scale or rust, sand, stones, bits of wood and rags, and sometimes catalyst from the cracking towers. Fuel-oil additives can dissolve or disperse most of the sludge but not the "sticks and stones." They must be cleaned out manually.

Typical sludge. A sample from the bottom of a residual storage tank contained 14% oil mixed with sludge and water, 48% water in a free state and emulsified with oil and sludge, 38% compounds insoluble even in benzol. This 38%, in turn, analyzed as follows:

Carbon	53.70%	Nitrogen	2.12%
Hydrogen	5.90%	Oxygen	2.90%
Sulfur	2.61%	Ash	32.70%

In combination, the carbon, hydrogen, oxygen, sulfur and nitrogen form the organic sludge. The ash—inorganic compounds that can't be eliminated readily—amounted to 12.4% of the total sludge. This is a large percentage, but the 2500-bbl tank was badly rusted and much tank scale dropped in the oil.

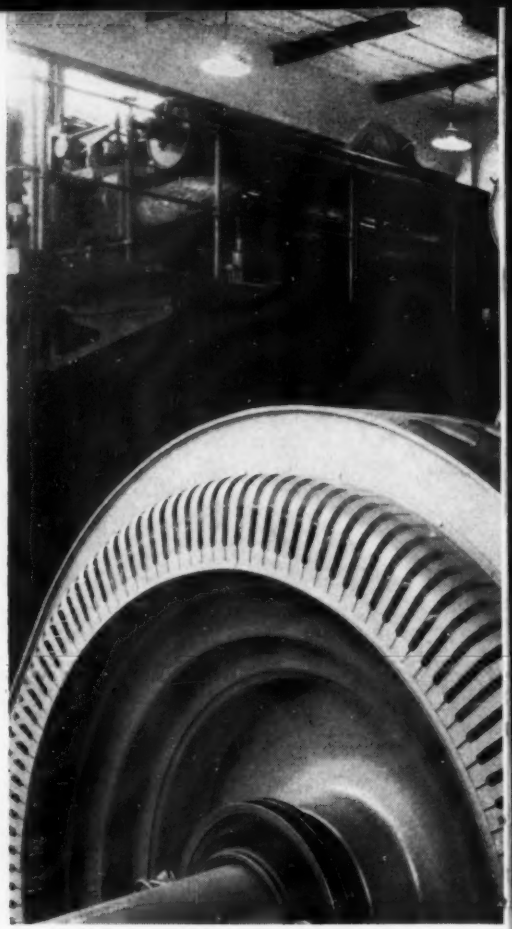
Ash composition included iron, sodium, aluminum, calcium, silicon, lead, magnesium, titanium, copper, barium, chromium, tin, manganese, cobalt, bismuth, vanadium, nickel, antimony, zinc, molybdenum and arsenic, in that order.

Now that we have some idea of heavy-fuel sludging, we're ready for the next article, dealing with what additives will do and how to use them effectively.

OPERATORS' NOTEBOOK 78

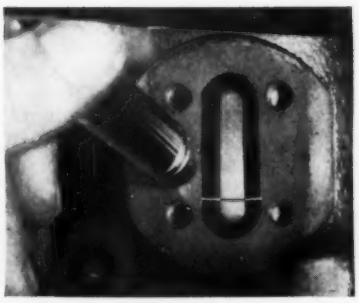
By STEVE ELONKA, *Associate Editor*

Let's time your dual-fuel engine and tune it up in 5 careful operations



1 Find top dead center . . .

2 Mark flywheel . . .



3 Time fuel pump . . .

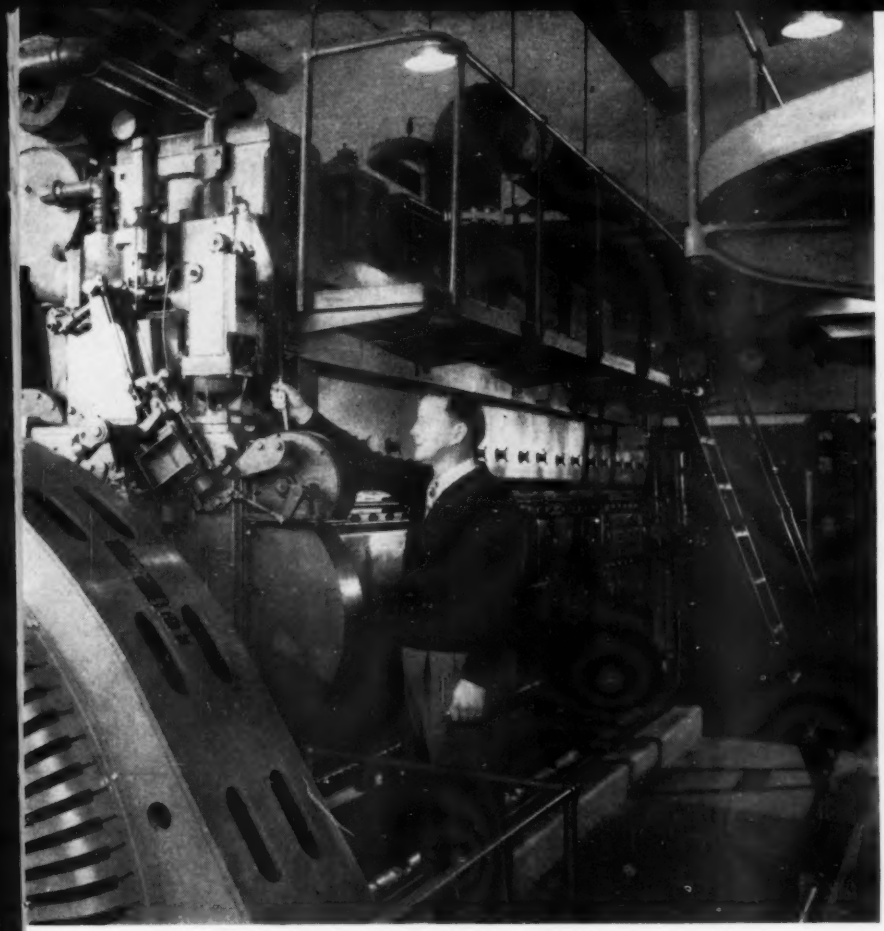
1 Establish your engine timing marks

► SUPPOSE you have to time a dual-fuel diesel that has no marks on the flywheel, then tune up the engine from indicator cards and make all adjustments so the engine is ready to roll. Can you do it? If not, read on.

To get this story right, I trailed my old friend Fred Carter, erection superintendent for Worthington Corp. Engine shown is a 16x20 dual-fuel job, 8-cylinder, 4-cycle, 360-rpm and 130-bmep.

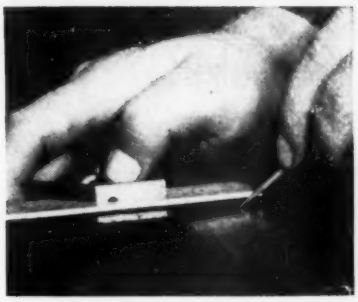
1. First, place No. 1 piston top dead-center (TDC). For stationary engines, place protractor (water level) against crank web. With web vertical, piston is on TDC. For marine engine, use a trammel (see Operators' Notebook 17, May 1949) as these engines aren't level.

If flywheel is already marked with TDC, see that pointer over flywheel aligns with this mark on it when crank web is in true vertical position. *Note:* This check must be right because all initial fuel-injection settings are made from these TDC marks, then used as a base for fuel-injection measurement.

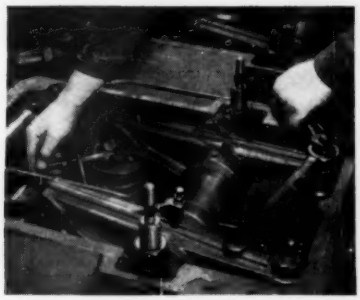


OIL AND GAS—they're both the same to this engine. But for top performance, know how to keep your engine in tune

4 Check port closing marks . . .



5 Find fuel-port closing spot . . .



6 Set valve clearances

2. With crank on TDC, place square against flywheel rim to check wheel marking with pointer on engine frame. If there's no pointer or mark on engine frame (new engine), scratch mark on frame where scale in photo touches the frame opposite flywheel. Check remaining TDC marks for other cylinders on flywheel in same way for accuracy.

3. With TDC marks on flywheel correct for all cylinders, check timing marks on fuel-pump window frame, aligning with pump-cup guide. When marks line up as in photo, fuel port is at closing position.

4. Check distance of port closing marks before TDC on flywheel rim. Make this check for each cylinder.

5. Next scribe fuel-port closing position on flywheel rim opposite centerline mark on engine housing.

6. Now set inlet and exhaust valve clearances at their initial "cold setting." You can do this at same time you make TDC checks. Be sure to set valves on combustion stroke while they are in closed position. This is very important.

To help this work and other checks, firing order of engine is stamped on plate attached to engine. After setting clearances on one cylinder, follow firing order for remaining settings by jacking flywheel to cylinder TDC marks and repeat for each cylinder.

Make the final "hot settings" of inlet and exhaust valves later while the engine is running at full load and gets to normal operating temperatures.

(Continued on next page)

1 Test the spray valve . . .

2 Take the spray valve apart to make adjustments . . .

5 Reassemble spray valve with a torque wrench . . .

6 Test spray again . . .

OPERATORS' NOTEBOOK 78 continued

2

Check fuel injectors and fuel pumps

1. Remove spray valve from cylinder head and test for opening pressure. Gage shows pressure of 3600 psi, which is 100 psi too high for this engine.

2. Dismantle spray valve so you can adjust the opening pressure setting. Torque wrench shown is not needed to take injector apart; use any wrench.

3. Remove shims from inside spray valve to lower opening pressure to 3500 psi. Shims vary from 0.002 to 0.0365 in. for pressure settings. If opening pressure is low, add shims. There is about 100-psi change per 0.010-in. shim when setting is close to specified 3500-psi opening for this engine.

4. Clean spray holes in nozzle to assure an even spray pattern. Holes are 0.018-in. diam—clean with 0.016-in. wire supplied by maker. Do this job at regular intervals if possible.

5. Reassemble spray valve with torque wrench, using 400-lb torque pressure. This wrench is a good investment. It helps place right tension on valve casing and working parts. Your engine maker will give you right torque pressures for various engine parts. Hold spray valve firmly in vise.

6. Test spray-valve opening again now that you have removed a shim. Gage shows 3500 psi needed, which is pressure when valve "breaks" to atomize fuel oil.

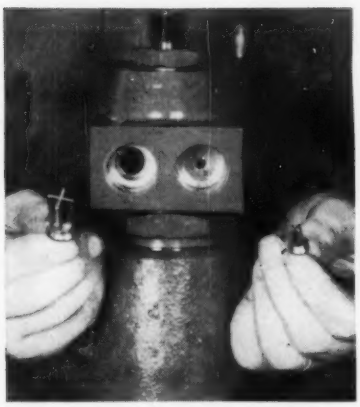
7. Dismantle dual-plunger pump and check seats of main delivery and pilot-plunger delivery valves. Seat must be especially right for pilot-plunger valve as it meters tiny amount of fuel oil.

8. Check metering edge of plunger for erosion and scratches or wear grooves that cut down pump efficiency. This is a ticklish job and parts must be absolutely clean. When reinstalling barrel and plunger in pump body, make sure both are free of tiny dirt particles. Don't use rags in handling parts. Threads often get in pump, causing trouble.

3 Remove shims . . .

4 Clean spray holes . . .

9 Align fuel control-rod . . .



7 Check dual-plunger pump . . .

8 Look for erosion . . .

9. Now check the pump control-sleeve and the metering fuel control-rod teeth for fitting. Tiny white timing marks on both control sleeve and the fuel control-rod must align with one another as shown. Fuel pump is timed from these reference points.

10. Next check fuel pump's timing-mark alignment with control sleeve and control rod after reinstalling in pump body. Dots must line up as in step 9.

11. Measure width of pilot-oil timing washer and record. This washer times pilot oil when engine goes into gas operation. Thinner washer advances pump timing, thicker retards it. Every 0.002 in. makes about 4-psi difference in pressure.

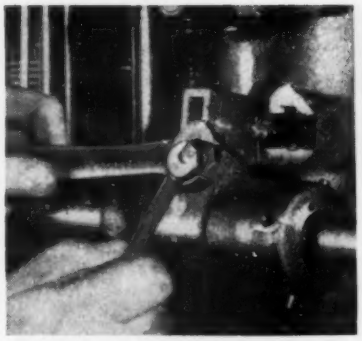
Raise or lower final gas-operating combustion pressures needed with these washers. Usually you won't have to change washer as pump maker installs the right dimension for your engine.

(*Continued on next page*)

10 Check inside of pump . . .

11 Measure the timing washer

1 Take exhaust temperatures...



2 Adjust pump rod's length . . .

3 Check cylinder temp again . . .

6 Study cards for unbalance as Fred Carter is doing . . .

7 Check lines with rule . . .

OPERATORS' NOTEBOOK 78 continued

3

Take indicator cards and balance engine

1. Now that you have made oil-operation checks, start engine, apply the load. Next use selector switch, record exhaust temperature of each cylinder.

2. Adjust fuel pump metering-control-rod so temperature is same from all cylinders. First loosen lock nut and adjust setscrew as shown. To raise temperature, screw in—to lower, screw out. When temperature for a cylinder is right, tighten lock nut as shown.

Each pump's control rod has reading in mm. If amount is more than 2 mm on any rod, check that pump's timing and corresponding cylinder pressures. Reading on all control rods should be as nearly the same as possible.

3. Check cylinder temperature again. Here it is exactly right, 820 F. All cylinders must be same.

4. With exhaust temperatures all the same, take indicator cards. Always blow out indicator cock before attaching indicator. Unless you do this, tiny carbon particles may plug pressure passage in line, giving faulty readings. Take cards of cylinder-combustion pressure balance at full load only.

5. Combustion-pressure balance card shows if each cylinder is doing its share of work. Remember that cylinder temperatures may balance perfectly, yet combustion pressures be out of balance. This is the most important of all balancing operations.

6. Study pressure card for unbalance by checking against engine maker's instruction book. This book also tells you right indicator spring to use. Ruler for measuring the pressure lines must have same pressure rating as on indicator spring to tell the right story.

7. Here No. 7 cylinder's firing pressure is low, while ruler shows other pressures fairly well balanced around 800 psi.

8. Check to see that aligning mark does not go out of window at top or bottom of fuel cam stroke. Photo shows that alignment mark is low but not out of sight for No. 7 cylinder.

If the required shimming won't cause this line to go out of the window at top or bottom, you can add shims. It is important that shims you add do not raise pump too high because that will jam the pump and cause damage.

What do you do if shimming does raise the marks high enough to leave window? Answer is that you must make needed adjustment by camming individual cylinders of the fuel pumps.

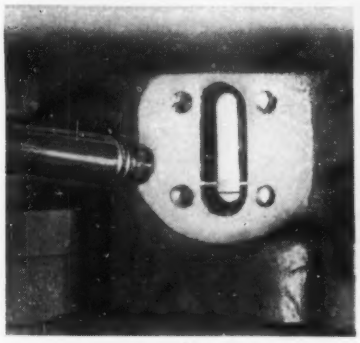
9. Insert shims under pump plunger to advance timing and to raise combustion pressure. Here pump has been removed from its base and fuel pump's push rod is protruding from pump opening (not shown in closeup). This push rod makes up contact between pump and camshaft's fuel cam. Cap for fuel pump's push rod that houses shims is shown at right of shim being miked.

Mike shims, then add 0.040-in. shim

4 Blow indicator cock . . .

5 Take combustion cards . . .

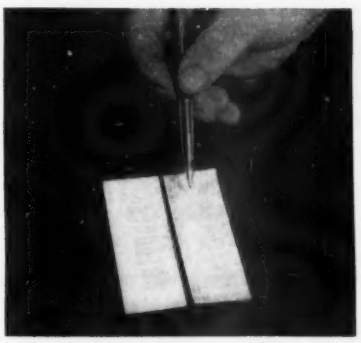
10 Adjust fuel cam . . .



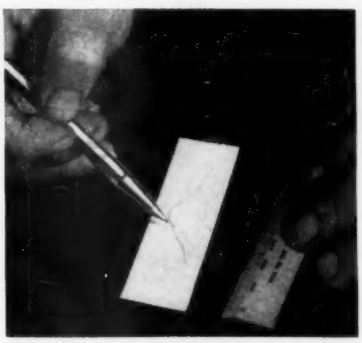
8 Check pump-plunger mark . . .

9 Insert shims under plunger . . .

11 Check temp again . . .



12 Compare indicator cards . . .



13 Take "pull" cards at full load

to raise pressure and also to bring up pump plunger's aligning mark. Do this by taking difference between desired combustion pressure and actual recorded pressure in psi. Then add one half that figure in thousandths of shim thickness to raise pressure.

Follow same method of removing shims to lower the pressures. This adjustment gives approximate correct pressure. Make final setting by caming.

Check pump aligning mark in pump window at stroke's bottom again after shimming. You will see that mark is now higher in window. So any danger of damaging pump from too low an aligning mark (out of sight) has been removed because of shimming.

Now check pump plunger's aligning mark in pump window at top of stroke. Aligning mark at top of pump stroke is about same distance from top of window frame as mark is from frame bottom with pump stroke at bottom. Check each cylinder's fuel pump like this.

10. Make final adjustment by fuel cam if combustion is still slightly low with pump timing marks centered in pump's window frames.

Use indicator card for this operation. To raise pressures, advance adjustable cam in photo—to lower, retard. Raising pressures gives you lower temperatures while retarding pressures gives higher temperatures.

Look at pump window, while moving cam to see that line on plunger and window are in line. For changing engine

(Continued on next page)

timing as a unit, advance or retard the camshaft gear. Original camshaft setting is checked by placing camshaft key on No. 1 cylinder in level position, then having crank throw of that cylinder read 48 degrees BTDC (before top dead center).

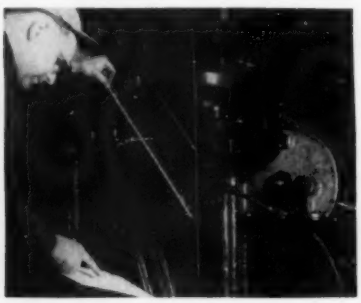
When over-all adjustment change is made to raise or lower pressures, the inlet and exhaust valve—as well as gas cams on some camshafts—have enough overlap so operational settings are not affected.

11. Check cylinder temperatures after caming adjustments. Note that temperature indicated is somewhat lower then reading before caming change. That's because adjustments raised pressures.

12. Take combustion-pressure indicator cards again and compare them with ones taken before making adjustments. Note that pressure balance is much better on AFTER card.

13. Take one set of "pull" cards at full load to further check individual cylinder performance. Cards show timing and firing point. Pencil points to firing point here. This operation is also an important check for fuel-oil performance of any type of diesel engine.

1 Examine relief doors . . .



2 Check linkage lengths . . .

3 Examine for tiny gas leaks

4

At this time make these checks too

1. With engine checked through for oil operation, check for gas operation. Then inspect the relief doors on alternate rear engine-covers for working freely (once a month). Also check diaphragm for possible rupture.

2. Refer to instruction bulletin and check linkage length measurement. This measurement is very critical as governor opening, gas shutoff position and amount of gas-rack lead are all affected by accuracy of these settings. You also determine transition to gas from oil and oil to gas—resistance on gas-rack movement.

3. Keep gas-piping connections tight. Check for leaks with a soap-and-water solution. Bubbling effect of soap quickly helps you find the smallest leaks.

1 Align top of gas plug . . .

2 Open all indicator cocks . . .

3 Roll engine on air . . .

4 Place on gas operation . . .

5 Adjust gas metering-valve . . .

6 Adjust gas-valve clearance

5

Now adjust engine for gas operation

1. With engine tuned up for oil operation, check top of gas-metering plug valve for alignment with metering edge of inlet sector of metering valve's casing. Do this by resting end of scale on both edges to find if flush. Have gas-fuel rack and governor in their "closed" positions during this check—and follow through on all metering valves on all cylinders. As soon as settings are made, make sure gas rack, metering valves and governor open and close as a unit. It's especially important that they close *all the way*.

2. Next open all indicator cocks before rolling engine over on air to purge system of gas. This is a precautionary step. With fuel pumps' racks in their closed position, pilot oil is being metered into the combustion chambers of the cylinders and any gas leakage or build-up will ignite and cause possible detonations.

3. Now roll engine over on air to purge system of any accumulated gas. Check the gas pressure to engine's metering gas-valves. It should be 12 psi on gage, which is average setting for natural-gas operation.

4. Engine is now ready to run on gas—so place on "no-load" operation. First place the manual control-lever on its gas position. Only other adjustment needed to change to gas operation is to open the master gas valve. Do this before placing the lever in its gas-operation position while engine is running on oil.

It's best always to start on oil and then change to gas operation at no load. When shutting down, it's also good practice to change to oil from gas operation. That allows fuel pumps to operate on oil, which they would not do otherwise.

With selector switch, check full-load cylinder's temperature balance.

5. Next, adjust gas-metering valve's reach-rod length to balance the cylinder temperatures at full-load operation. Loosen lock nut, then turn reach rod *into* clevis to lower temperature—screw *out* to raise temperature. Make needed adjustments in all cylinder metering-valve reach rods to balance the temperatures.

To raise or lower all cylinder temperatures as a unit, lengthen or shorten the adjustable-rod connection between gas rack and governor. Caution! When shortening this connection too much to raise temperatures, the *close* position of gas rack might affect shutting off the gas because metering valves are partly open.

You are now ready for final cylinder temperature-balance at full-load gas operation. With temperatures balanced, take indicator cards at full load to balance-out combustion pressures. Use same procedure as shown for oil operation.

6. If final combustion-pressure balance is slightly off, you can adjust gas-injection valve clearance. Tappet clearance has adjustment range of 0.012 to 0.020 in., *less* clearance to raise pressures and *more* to lower them.

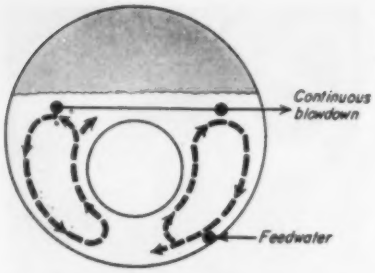
Caming adjustments can also be made for pressure settings and balancing. If you must make over-all pressure adjustments, use pilot-oil fuel pump's timing washer shown for setting fuel pump.

When temperatures and combustion pressures have been balanced out according to instruction book, engine is ready for service on either gas or oil operation.

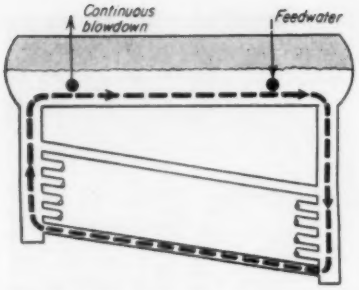
Be sure to test all alarm and shutdown devices on engine. You must also check and actuate the auxiliaries at set periods to make sure you have maximum protection at all times.

This engine has many exclusive features. They are: throttling air at light loads to improve operation and fuel consumption on gas operation; changeover when on gas or oil operation that's affected only by gas-pressure failure or manual control. These devices must also be checked from time to time if you want dependable operation from this or any engine.

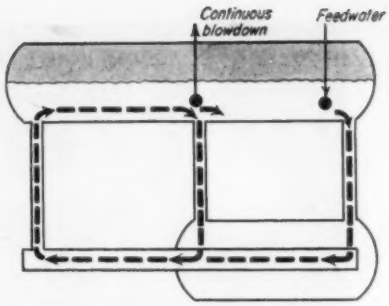
Now that engine is timed for both oil and gas, work out a preventive-maintenance program as recommended by the maker. Keep a careful log and study it for possible warnings of trouble. The most successful diesel operators know their engines thoroughly, thereby keeping them at peak performance, with minimum shutdown. It's the only way.



FIRETUBE package boiler has water circulating in crescent on sides of furnace



STRAIGHT-WATERTUBE boiler has takeoff in the front quarter of the steam drum



ONE-AND-HALF 2-drum boiler: continuous blowdown takeoff across steam drum

Second of two basic articles

Blowdown: the mechanical control angle

By **PAUL BRINDISI**, *Chemical Engineer, Celco Laboratories*

► WE DISCUSSED chemical control over boiler blowdown last month (page 116). Here we will consider the proper blowdown procedure.

Blowdown valves. All pressure boilers are equipped with one or more pairs of bottom blowdown valves. Other than a special inverted type, the conventional valves are installed to receive pressure from above their shutoff disks.

Regardless of how low the operating pressure, never use a globe valve for blowdown. This goes for bottom or surface discharge. Because of its S-shaped seat design, scale bits are apt to collect in pockets above or beneath the valve disk. Boiler pressure tends to pack this deposit rather than free it. Valves having the straight type of seat, such as the cock, gate or sleeve makes, do the best job for blowdown purposes.

Of the two bottom blowdown valves, the one closest to the boiler (inside valve) is commonly designated for blowing, while the other (outside valve) acts as a sealer. For low to moderate pressures, the inside valve is normally a quick-opening type—either the cock or the swing-gate variety (see valve illustration facing page). A slow-opening valve is used on the outside. In the medium-pressure range, both are usually seatless, slow-opening valves. At high pressures, they are also the slow-opening type, but the inside valve normally has a hard-seat disk. Various makes and combinations may be employed.

Blowdown procedures. Although controversy has arisen as to which of the two bottom blowdown valves should be opened first, the long-approved practice is to open the outside valve first and close it last. On blowing down, open it wide.

After opening outside valve, start opening the inside blowing valve slowly to avert shock to the blowdown line—but only for a moment—then quickly open it full to prevent wire-drawing of the valve seat. Never blow down through a partially opened valve. Keep your hand on the blowing-valve handle while making the blowdown.

In closing this valve, we again turn it slowly for a moment, then rapidly make it tight. Do not force this valve closed. If it does not shut easily, reopen quickly. The boiler pressure will soon dislodge any scale pieces trapped in the valve and it can be reclosed. We then close the outside sealing valve.

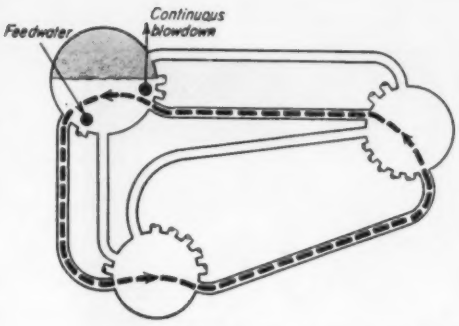
With the blowing valve holding securely, the sealing valve soon cools. Should it remain hot for some time after blowdown, the inside valve is undoubtedly leaking. Check to be sure this valve is fully closed. If leakage continues, arrange to have the boiler come off the line at the very earliest time.

When to blow. The principal purpose of periodic blowdowns is to rid the boiler of its precipitated hardness. This is best accomplished during the low-load or idling periods when such deposits are more apt to settle out.

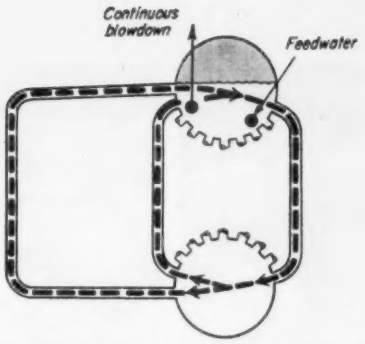
Because there is greater disturbance in the boiler at heavy loads, only a small portion of the circulated suspended solids is expelled. A considerable volume of boiler water is thus needlessly wasted at a time when we should be conserving water and heat. The already high makeup needs are further increased, and fuel consumption is raised. To add to this, an increase in chemical feed is needed. The net result is that we now have more precipitates in the boiler than we would have had with no blowdown at this particular time. Accordingly, sludge blows during heavy loads should be made only in emergencies, such as high-water level, sudden priming or foaming.

A minimum of one sludge blow daily may be allowed for small boilers operating at very low pressures and used exclusively for heating. All other pressure boilers, however, must be given at least two bottom blows per day. These are fixed standards. At no time should they be eliminated, even when a decreased rate of blowdown reduces them to mere puffs.

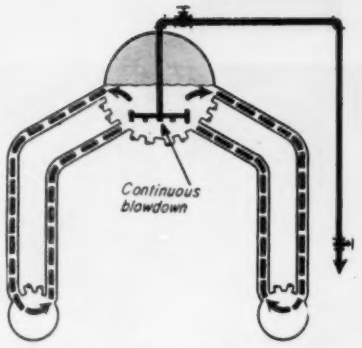
For a normal 8-hour work day it is best to establish one such blow in the evening, some time after the drop in load has leveled off. The other should be in early morning, just before the load is to rise again. When additional blows are required, they should be spaced equally between these two primary ones, preferably concentrating them during the low-load period.



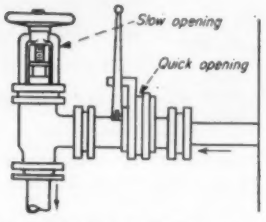
THREE-DRUM bent-tube boiler: continuous blowdown takeoff in upper-rear drum



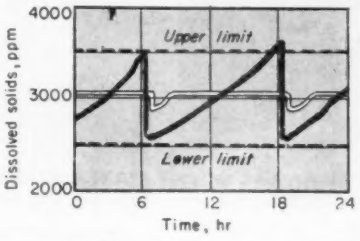
TWO-DRUM bent-tube boiler has donut circulation with takeoff at end of cycle



ONE-DRUM package boiler generates most steam at rear, hence takeoff at the rear



TWO BLOWDOWN VALVES. Quick opening one for blowing, the other for sealing



SOLID LINE: long intermittent blows; other: continuous and short sludge blows

Where an over night drop in load does not exist, make the two standard bottom blows at known points of lowest steam demand. Any added blows must then be conducted during periods of reduced load.

Waterwall headers. In larger boilers, waterwall headers have individual pairs of blowdown valves. Blowing of these valves is a separate function from that of the mud drum. On these valves, the blows must always be short, else there is danger of momentarily starving the waterwall tubes and causing their overheating.

Each header must be given one short blow once per work shift. And regardless of the over-all rate of blowdown observed, these blows should never be increased, either in number or length. They are to remain fixed at the prescribed time and measure.

Length of blows. A common practice is to judge the length of bottom blows by the water-level drop in the gage glass. But a closer regulation and comparison is possible with the count system.

In this method, you begin with a basic blow of about 10, 15, or 20 seconds duration. You do that in actual timing or by counting off at intervals of a second. The blow is measured from the time the blowing valve is fully opened to the moment of its closing. Using this count as a guide, you increase or decrease the length of your blows thereafter as needed.

A greater volume of water will be released per given time with increasing pressure. And some boilers, because of design and water capacity, are more sensitive to blowdown than others. Hence no common counts can be employed. At high operating pressures a count of ten may be appropriate. In the medium-pressure range 15 could be used. And for the moderate-to-low pressures 20 is suitable. A fixed count of not more than half the basic sludge blow is needed for waterwall headers.

Sludge control. A close check of the boiler's sludge condition should be kept. Blowing down the water column and observing turbidity in the gage glass is not good enough. You should set aside a sample in the same-size containers each day for comparison of time of settling and extent of sludge deposited. Maximum permissible percentage is dependent on the chemical control used for your particular operating pressure.

When boiler-water concentrations are within desired limits, but the sludge is too heavy, use an increased number of short blows. Four short blows remove far more sludge than two doubly long ones. On the other hand, long blows provide quicker adjustment where the sludge is not the primary problem, but the boiler water's dissolved solids content is higher than recommended.

Continuous blowdown. Often a fairly high rate of blowdown becomes necessary to properly control boiler-water alkalinities and total dissolved solids. Numerous bottom blows are then needed. This means added manual labor and greater irregularity in boiler operation. In such cases, the installation of a continuous blowdown system is indicated.

Continuous blowdown is but a supplement, not a substitute for the indispensable sludge blows. This additional steady discharge of boiler water must be in sufficient quantity to warrant such a system. Too small a flow causes repeated plugging of the blowdown line and fouling of its regulating valve. Intermittent operation would do the same.

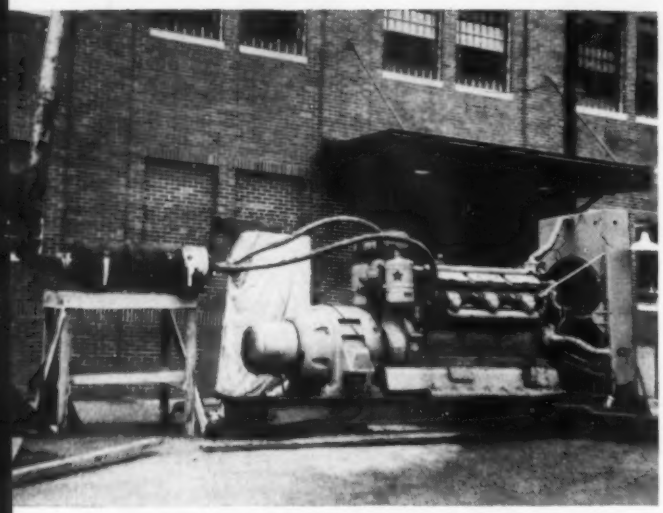
Continuous blowdown offers a twofold advantage: It permits removal of highly concentrated water without disturbing the boiler performance (see graph at top of page). And much of the heat in the blowdown water can be recovered.

A flash tank may be used to make steam at reduced pressure. This steam can serve to deaerate your feedwater. Where a flash tank is not justified, the blowdown water can preheat your makeup water in an exchanger only. And, if required, a small portion of the highly alkaline blowdown water may be circulated after the deaerator to protect your economizer and feedwater line from possible corrosion.

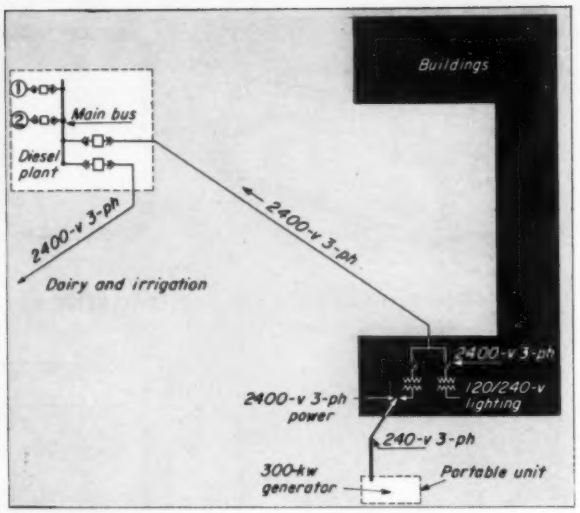
Takeoff position. To be effective, your continuous blowdown takeoff should be placed where the boiler water has its highest concentration of dissolved solids. This corresponds to the point where the greater part of the steam separates from the boiler water. This may be at the end of the water's cycle through the boiler or only three-quarters of the way around, depending on the design of your unit (see illustrations top of this and facing pages).

The point of feedwater entry marks the beginning as well as the termination of the boiler water's circulation. In

(*Continued on page 196*)



PORTABLE DIESEL rig was trucked over 200 miles, then set up on plant grounds, serviced, ready for load within 24 hours



PLANT VOLTAGE was 2400 but portable generator rated 240 v. So power was fed back through transformers' low-voltage side

Are you ready for a fast switch to

Here are the problems you may face in getting a portable diesel generator on the line and carrying plant load

► WHEN YOU'RE COASTING ALONG with 350 kw divided on a pair of 18-yr-old diesel generators and suddenly lightning hits, insulation is bound to give when nature's effort mixes with your 2400 v. Ours did, with the smell of burned insulation, throbbing engines, and then complete darkness about 3 am one Saturday morning.

Operation blackout. Then began the job of installing a portable unit to handle the light and power requirements for one of the nation's largest prison farms. Missouri runs this $1.5-million show place, 12 miles outside Jefferson City.

It's just too far out for an REA or utility loop. With 250-350 kw demand the 7-mile run to utility high-capacity distribution transformers would be too costly.

Blackout affected complete plant operation and the physical comforts of over 350 trusty convicts who work the 2316 acres. Fortunately, this very power failure had been considered long ago and we contacted the local "Cat" distributor, who managed to locate a portable unit at Flora, Ill., some 226 miles away.

Loading of the 15-ton self-contained power unit started there at noon. We were then nine hours without juice. Water supplies began to get on the critical side as the inmates and the 368 registered Holsteins made a big dent in the 50,000-gal water tank.

Portable rig. A hitch almost developed in the operation when it was learned from Flora that the generator was a straight 220-v 3-ph, instead of 2400-v which we had planned. A 2.4-kv unit could tie directly to the plant bus.

A map of the electrical distribution system for this Auxiliary Prison Farm had gone astray after 18 years. But from electricians who had shot trouble on this system we could draw up a one-line schematic of the distribution system.

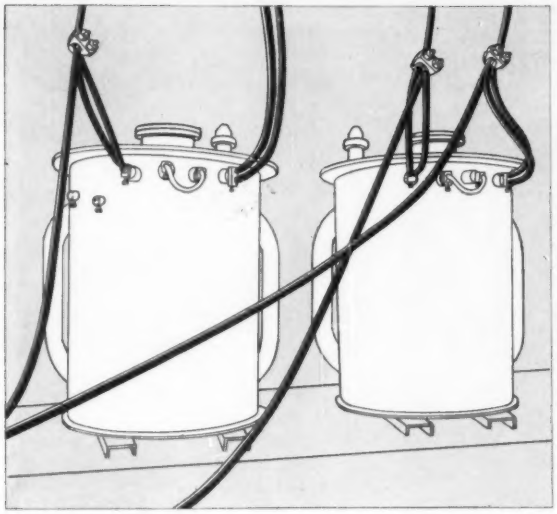
We decided that our best bet with the 240-v generator was to tie in directly at the biggest power panel at the farm. We could then make 2400 v by backing up 240 v through the transformers, placing higher voltage on the diesel-plant bus and then out again to other system points.

However, a check showed that the bolts on the 240-v power-panel terminals wouldn't take another cable connector. So it was necessary to try and tie directly to the transformer secondary leads. This arrangement was really better as it fed a large block of 240 v directly to the main power panel for the water pumps, various building power requirements, kitchen ranges and other high kw demands. Calculations showed that the transformers on this back-up plan would be loaded about 40% in this reverse operation.

Temporary cables. Fastest way of connecting the generator to our system was to lay three No. 4/0 cables through a window and then 150 ft down a hallway into the transformer vault. It took two hours to haul the cable from our Jefferson City Prison stock, strip the insulation on the transformer leads, and make the taps. No taping was required as we had ample spacing between phase connections. A wooden plank, drilled for the three cables, protected against chafing as they passed through the window.

As we measured this 150-ft distance, our stock crews reeled off the same length and made their cuts. This speeded up the job and eliminated handling a bulky 450-ft reel of cable in trucking and unloading.

With the portable rig promised for delivery around 10



TEMPORARY FEED of No. 4/0 cable was run exposed between diesel rig, transformers. Taps made with solderless connectors

emergency power?

By L W FITZPATRICK, *Chief Engineer*
Dept of Correction, Jefferson City, Mo.

pm, this meant working in darkness. Two 1-kw portable gasoline plants were spotted at the site to help unloading.

Promptly on time the lowboy came on the scene with the 500-hp 312-kw 12-cyl 1200-rpm unit, commercially known as a D397-ES. To conserve time our electricians immediately began to check the portable switchboard. Someone had removed the solderless cable lugs on main bus and generator terminals. This was easily handled from work-truck stocks.

Unloading operations then began to run into a snag. In the hurry to get off to Jeff City, it was necessary to use a lowboy that wasn't exactly low. This meant rounding up quite a bit of 6x6, 8x8 and heavy planks for shoring. Unloading then started. A winch dragged the generator end of the skidded unit, which dipped to the ground as the heavy engine end remained angled on the lowboy bed. Then I beams on the generator end were anchored to the building walls, the tractor was pulled up about six feet and the front end was ready to be lowered.

Timbers to level that end to the lowboy bed were placed, the tractor quickly pulled the float away, and the unit was angled on the timbers. A pair of 30-ton hydraulic jacks then took over, raising the end so blocking timbers could be removed. Jacks were then released and the entire unit was safely on the ground.

Dealer's installation crews went in high gear. After checking the engine, filling the 70-gal fuel tank with No. 2 diesel oil, it was ready to run a few minutes after 2 am.

Operation was continuous with the exception of one 30-minute shutdown to check lube oil. Fuel consumption averaged 9 to 10 gal per hour; lube oil, 1.67 gal per day. We replenished fuel before it dropped below ¼ tank, because air could clog the fuel system. With air in system, manual fuel-oil pump will purge, but it takes about 15 min of continuous stroking.

Our diesel men took over the operation without any technical difficulties. It was extremely simple. This portable unit had about 1200 hr previous service and a complete set of safety shutdown devices in case of low lube-oil pressure, over-speeding, over-heating, etc. Engine cooling was handled with a large 8-ft radiator fan blowing a blast over the entire engine, generator and switchboard.

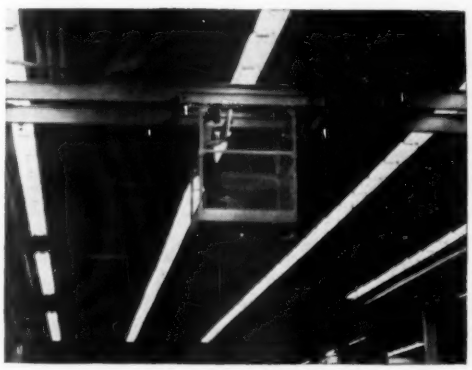
Instrument panel. Portable-generator panel was complete with voltmeter and ammeter. Generator protection was provided by mechanically operated circuit-breaker release in event of a fault or overload. Canvas tarp furnished enough protection to switchboard during the slight rain.

As to cost, these units rate high money. Figures, which are uniform throughout the U.S., are based on the Associated General Contractor's charts. They cover rental costs for heavy power scoops, air compressors and heavy earth-moving rigs.

Ten days later one of our generators had been rewound and tested. "Operation blackout" was nearing its end. Fuel to the Cat was stopped, cables removed from our transformers, and once again our venerable diesel put power into our farm distribution system.

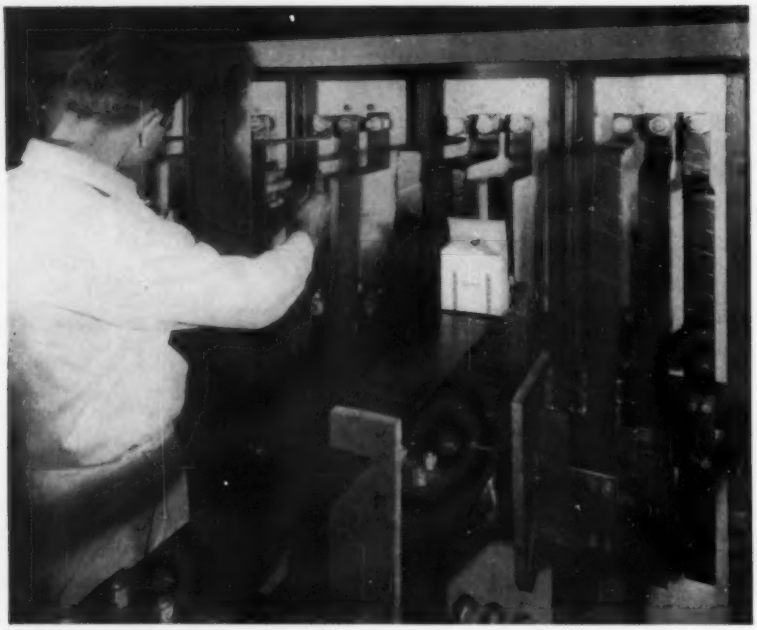
Here's what it cost to rent a 300-kw portable unit

Freight, Flora, Ill. to Jefferson City, Mo.			$352.00
Return from Jefferson City to Flora			352.00
Labor: unload, set up and service			208.40
Labor: reload, remove			208.50
Rental rates	Month	Week	Day
24-hour basis	$3500	$1165	$340
12-hour basis	$1750	$ 530	$195
Servicing per week, labor			$ 50.00



Crane speeds lighting upkeep

Utility crane at the new jet assembly plant of Grumman Aircraft in Calverton, L. I. plays a big part in general maintenance. It also trims cost of cleaning and relamping lighting fixtures.



WRAPPING COPPER BUS in plastic tape gives safe job that may run degrees cooler

Covering a bus with dark insulation means more than electrical protection. Morris Brenner, Associate Technical Service Engineer, Burndy Engineering Co, points out why a . . .

Taped electrical bus runs cooler

► CURRENT-CARRYING CAPACITY of a bus is limited by temperature rise. Most equipment connected to a bus is designed to operate at a temperature rise of 30 C above a 40-C ambient. If a bus is to operate at a temperature greater than 70 C, heat flows from it into connected electrical equipment.

Here's another factor influencing bus temperature: Copper starts oxidizing excessively beyond 80 C. So if temperatures beyond 70 C are expected, it's good practice to silver-plate where connections will be made to the bus.

Value of current needed to raise bus temperature 30 C, beyond a 40-C ambient, depends on bus size and its ability to dissipate heat losses. If bus is outdoors, heat dissipation hinges on wind, sun, radiation and convection. Indoors, heat given off depends principally on radiation and free convection, the latter coming from rising currents of surrounding air.

There are other elements that tend to increase current-carrying values: intermittent loading, natural drafts, fans and cooler connections. On the other hand, intermittent overloads, poor connections and limited air circulation tend to reduce current-carrying values. Nonmagnetic ducts may decrease current rating up to 25%. Magnetic housings can decrease carrying capacity by 35 to 40%.

Several factors, inherent in the shape and condition of the bus itself and independent of external conditions, are important in determining current-carrying capacity of a bus. Among these factors are *emissivity*, *skin effect* and *proximity effect*. Emissivity is the rate of heat radiation from a conductor.

A black, well-oxidized conductor emits up to 25% more heat than one brightly polished. In some cases, a bus covered with a dark-colored insulation may carry more current, for a given temperature rise, than the same conductor without insulation. Reason: The larger surface presented by the insulated conductor and higher emissivity, if the insulation is black. These factors may more than offset the temperature rise caused by the reduced thermal conductivity of the insulation.

Effect of emissivity on heat dissipation

Copper surface	*Radiation emissivity coefficient*	*Heat dissipation, watts per sq ft*		
		Radiation	*Convection*	*Total*
Polished	0.03	0.68	13.44	14.12
Shiny	0.07	1.58	13.44	15.02
Slightly oxidized	0.3	6.76	13.44	20.20
Normally oxidized	0.5	11.27	13.44	24.71
Heavily oxidized	0.7	15.78	13.44	29.22
Gloss paint	0.9	20.30	13.44	33.74
Flat paint	0.95	21.43	13.44	34.87

DRY CHEMICAL handles motor fire without harming commutator

Snuffing a motor fire

► FIRE-PROTECTION EXPERTS have recognized for years the value of dry-chemical fire-fighting equipment when battling electrical fires. But some engineers hesitated to adopt it: They worry about possible abrasive damage to sensitive equipment. Ansul Chemical Co of Marinette, Wis., released test data showing the chemical can be used on electric motors without danger of abrasion. Test used a 7½-hp 550-v open-type dc motor and two 4-lb dry-chemical extinguishers.

With motor running, one 4-lb extinguisher was emptied into the motor through both end bells. Armature, field, commutator, brush holders and all other parts were thoroughly covered with the dry chemical, a specially treated sodium bicarbonate. Motor continued to operate, with normal ventilation carrying off the excess of the dry chemical. Even the contents of a second extinguisher failed to do any harm to the motor.

Motor was carefully inspected afterwards and opinion advanced that there was no need to dismantle or overhaul other than to relubricate the bearings. Apparently there was no abrasive damage to the commutator. Where motor uses ball bearings it was felt an air-hose cleaning, without dismantling, was sufficient. However, for motors equipped with sleeve or roller bearings, the opinion was that bearings should be drained, flushed and relubricated in addition to cleaning remainder of motor.

480 volts gaining ground in office buildings

► DEMAND in the modern office building may run from 1500 kva, for a small 5- or 10-story building, to 6000 kva in the larger 30- or 40-story structures. Years back, office-building load averaged 1 or 2 va per sq ft, while today it runs between 4½ and 10, with the increase expected to continue.

As pointed out by W W Henderson and H N Hickok during the recent AIEE Summer & Pacific General Meeting in Los Angeles, loads of this size put the modern office building in the same class load-wise with many industrial plants that may average 5 to 15 va per sq ft.

Two main reasons for this load growth: air conditioning and better lighting. Power loads now include air-conditioning compressors, elevator motors, fans, water pumps. To a lesser degree load growth has been affected by increased adoption of office machines.

In light of these heavier loads, much thought has been given in recent years to higher distribution voltages in office buildings (POWER, March 1954, pp 74-75). Engineers are examining closely the possible use of a 480Y/277-v power system rather than the conventional 208Y/120-v network voltage. Studies to date show a lower installed cost using the higher voltages.

Many factors come into the picture in determining feasibility of using 480Y/277. First consideration is whether 480 v is available in the area from the local power company. Where only 208-v power can be had, auto transformers may be used to step up voltage inside the building. Such transformers cost about $8 per kva.

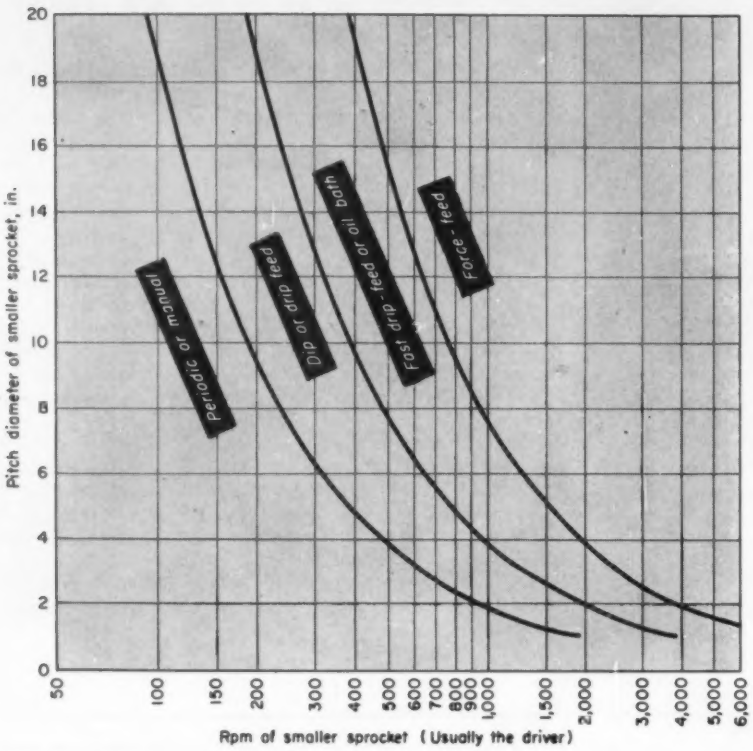
Where power can be bought at a still higher voltage, say 13.8 kv, an alternate plan is to step this voltage down inside the building to 480. Buying power at a high voltage trims the power bill somewhat, and in time might write off the transformer cost. Some power companies today, especially in large cities, are finding it practical to provide this higher network voltage to customers who are using large blocks of power.

Other utilities will provide only 480-v delta service. If such is the case the design engineer laying out a new service must provide for a grounding transformer to get a 480Y/277-v system. As in buying an auto transformer, mentioned above, cost of a grounding transformer would whittle back some of the possible savings of the higher-voltage system. But the higher-voltage scheme should still be considered and worked out on a final cost basis for comparison.

Until last year there were certain restrictions on the use of a 480Y/277-v system in office and similar type buildings. The National Electric Code did not permit general use of electrical systems having more than 150 v to ground. Recently the Code has been amended, permitting systems up to 300 v to ground. The only present remaining restriction is that lighting circuits using this higher voltage must be in the walls, or otherwise not integral with the fixtures. Thus, the trend toward this higher-voltage system now has the blessing of the National Electric Code.

Building configuration is perhaps the largest single-factor in determining how much can be saved. Greatest cost reduction comes about when the area per floor is small compared with the number of floors. This can be traced to the fact that a large saving is made in size of cable or bus duct, or both, used in building risers.

Lubrication chart for standard roller chain



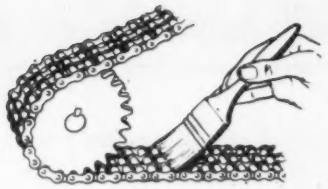
USE THIS CHART to pick best lubrication method. Example: If a 12-in.-dia smaller sprocket runs 150-300 rpm, use drip-feed; if it runs over 650 rpm, use force-feed

Guide to roller-chain lubrication and maintenance

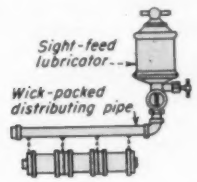
Here are 4 basic methods of lubrication, and a check list of what to do if you run into any operating trouble. Based on data from Chain Belt Co

Check list: adjustments and repairs

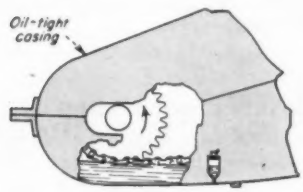
Symptoms	Possible causes	Remedies
Excessive noise	Misalignment	Check alignment and correct
	Too little or too much slack	Adjust centers for proper chain slack
	None or improper lubrication	Lubricate
	Loose casing or bearings	Draw up bolts, brace casings if needed
	Chain sprockets worn	Reverse or replace sprockets
Wear on chain side plates and sides of teeth	Misalignment	Remove chains and correct alignment
Broken pins and rollers	Chain speed too high for pitch	Use shorter pitch chain of equal or greater strength
	Shock or suddenly applied loads	Avoid shocks—easy starts give longer life
Chain whip	Long centers or high pulsating loads	Reduce centers when possible
	Too much slack	Take up slack
Chain gets stiff	Misalignment	Check alignment and correct
	Improper lubrication	Remove chain, clean, relubricate
	Excessive overloads	Reduce load when possible
	Corrosion	
Cotters come out	Vibration and centrifugal force	Invert chain so heads of cotters are on inside nearest shafts
Chain climbs sprocket	Poorly fitted sprockets	Reverse sprockets or replace sprockets and chain if necessary
	Severe overload	Reduce load if possible—lubricate driven machine
	Chain worn over length	
Chain clings to sprockets	Incorrect or worn sprockets	Reverse sprockets, or replace sprockets and chain if necessary
	Heavy and tacky lubricants	Clean chain and sprockets and lubricate correctly
Broken sprocket teeth	Obstruction—or foreign material in chain	Check chain clearances
		Drain and clean chain case
Shaft bearing wears excessively	Too little chain slack	Correct the adjustment



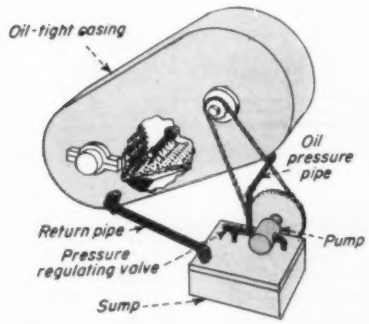
1 Manual lubrication. Apply oil inside chain at edges of the side plates. Use brush or spout can. Lubricate entire chain twice a week, oftener if needed. Regulate amount of oil used so none is thrown off



2 Drip-feed system. Use sight-feed lubricator and distributing pipe. Lubricate side plates on lower strand of chain, near sprocket engagement point. Regulate flow rate for complete lubrication without flooding



3 Oil bath. Chain runs through oil bath kept at pitch line in casing. Alternately, use slingers mounted on sprocket to throw oil on to the chain. Drain, clean housing and replace oil at least once a year



4 Force feed. For high-speed heavy-duty drives. Circulating pump system sprays inside of chain, excess returns to sump. Use quality oil and an oil-tight casing. Clean system, renew oil once a year at least

Roller-chain lubricants have 3-fold purpose

► REGARDLESS of the speed and load at which a chain transmission operates, and regardless of the lube system you use, your lubricant must accomplish three objectives if it is to be effective. It has to (1) provide pin lubrication (2) supply roller and sprocket-tooth lubrication (3) protect the chain against wear and corrosion caused by dust, dirt, moisture, chemical fumes and high temperature.

For proper pin lubrication, oil must be fluid at the operating temperature so capillary action can form and reform a film over the internal bearing surfaces of pins and bushings. This action provides continuous protection as the chain moves. Since shock loads on individual links become more frequent when speed increases, follow the practice of cutting load when increasing speed. This keeps bearing pressures on pins and bushings within design limits, prevents excessive wear.

Lubricating rollers reduces wear at the point of contact with the sprocket teeth. Correctly designed chain parts have enough bearing surface to take care of ordinary strains, but still require lubrication for easy, rolling contact.

Moisture, dust, dirt and chemical fumes in the atmosphere tend to work into the chain if the lubricant does not keep them out. They immediately increase wear, and will ultimately shorten useful life. Under these conditions, grease may be practicable. Grease in the chain clearances seals against entry of abrasive materials. To maintain properly, provide regular, thorough cleaning and regreasing.

High-temperature service requires special lubricants that will not completely volatilize. For such installations, consult a lube supplier.

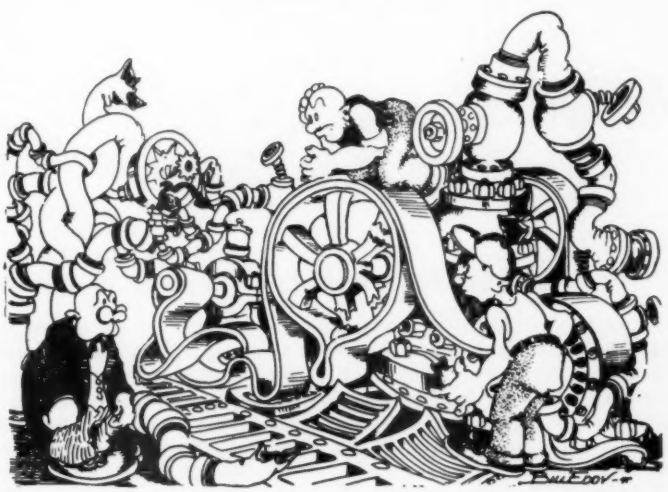
In all cases, keep in mind that lubricant must penetrate through the roller clearance spaces. It is fruitless to oil the chain surface if the wearing parts run dry.

For effective distribution, deliver oil of the proper viscosity to edges of the side plates. As chain moves, capillary action draws it into the chain joints.

When using a solid lubricant like petrolatum, submerge the chain in heated lubricant and leave it until air bubbles stop rising to the surface. This indicates that clearances between pins and bushings are filled. Let chain remain until lubricant partially solidifies, so it will not drain out.

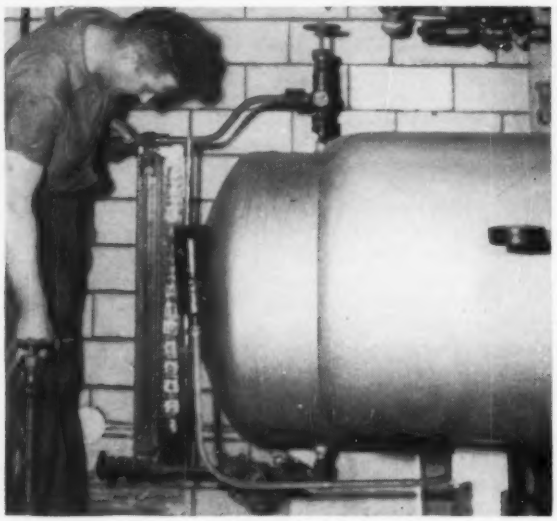
No. 9 of the Bill Eddy cartoons

Repeated by request



"Never mind writing me a report, Higgins, just issue a communiqué"

Timely PRACTICAL IDEAS *that will help you do a*



Good hookup for your ammonia receiver

THESE TWO AMMONIA RECEIVERS (gage glass on other end of first drum) were installed for trouble-free service. All lines are welded, double-valved, and all flanges have stainless-steel bolts, nuts.

Ammonia charge is about 5000 lb for entire plant. Pumpout lines are so installed that either condenser or receiver in system can be pumped out while other two are in service.

Gage glass is full height of receiver and has graduations so we know exact height of ammonia at all times. To keep sediment out of bottom glass connection, nipple extends an inch or so up into bottom of receiver. That prevents ballcheck in bottom glass-fitting from being plugged with sediment, then sticking, in case glass breaks and ball has to prevent ammonia from being lost. I understand there have been many cases of sticking ballchecks where there is no nipple inside receiver, as in ours.

R C HOGAN *Canton, Ohio*

Volt-ohm-milliammeters

BE CAREFUL of measurements with low-priced volt-ohm-milliammeters. Quality instruments have meter movements with higher full-scale accuracy. Most good instruments have a full-scale accuracy of plus or minus 2%. Multiplier resistors have a tolerance of 1% so that makes for 3% accuracy.

That 3% accuracy doesn't mean everywhere on the scale. For example: If the reading is 150 volts on the 150-volt scale, voltage is 147 to 153 volts.

But when you measure just 25 volts on the same scale range, true voltage reads 25 volts, but it could fall anywhere between 21½ and 29½ volts. Best range is ¾ scale for all checks.

Good trick when testing unknown voltages is to use high scale and then drop to lower range. If not sure whether you are testing ac or dc, set the meter for ac so rectifier protects the meter.

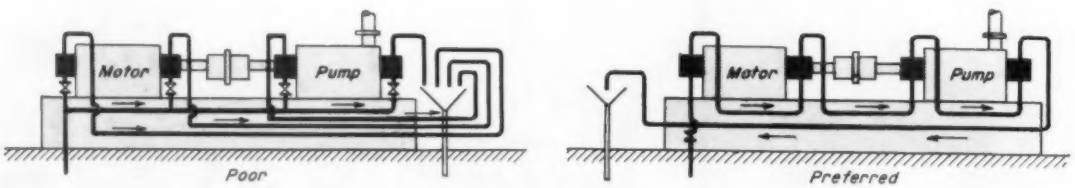
Constant-current transformer gives an accurate 115-v check for your voltmeter. Load the constant-current transformer to 75% of its rating for greatest accuracy.

L W FITZPATRICK
Jefferson City, Mo.

Lubricate wire rope

MAKE UP A THIN SOLUTION of shredded beeswax and carbon tetrachloride. Paint this on the rope. Carbon tetrachloride soon evaporates, leaving beeswax on and between the strands of the rope.

W E WARNER
Woodford Green, Eng.



Do you agree with Pef's idea of poor and good bearing piping hookup?

TROUBLE with cooling-water hookup to bearings in first sketch is that operator has four valves to watch and adjust. Then every time he has to adjust a valve he must walk back and forth to waste funnel to observe amount of cooling water coming through.

My idea of an ideal hookup for this installation is second sketch. Here he has only one valve to watch. Outlet is within sight and is near the only valve. Besides, there's less piping, the job is neater and takes less maintenance.

N T PEF *Boston, Mass.*

EDITOR'S NOTE: *In some installations last bearing serviced by cooling water in second sketch may run hottest. Yet it would get water preheated from the three bearings before it. To keep this last bearing at right running temperature, the only valve in system would have to be opened so wide that preceding bearings might run too cool.*

Hooking bearings in series is usually good practice, but depends on number of bearings in series and their running characteristics. What do readers say?

better operating and maintenance job

STEVE ELONKA, *Associate Editor*

What would you have done?

WHITE LINEN in our laundry seemed to be yellowing. Tests of hot water showed it contained a lot of iron. Water is from municipal supply, which is almost free from iron, so that put the finger on our storage heater.

Something had to be done right away. That Saturday afternoon, after plant had shut down, we flushed and cooled the tank. A stainless-steel base paint had been recommended to stop the rusting. After scraping and washing out the tank thoroughly, we applied two coats of acid to rusted surface, then neutralized it with diluted mixture of alcohol.

After the tank had dried out, we were supposed to give it a prime coat, let it dry for 4 hours, then put on finish coat. By doing the job Saturday night, it would be dry for filling and heating early Monday morning.

Thinking I had done worst part of job, I grabbed the pail of primer and brush, slid through the manhole, and eagerly slapped on paint. But paint fumes went into action. Before I had the rear head finished, my eyes were watering badly. I couldn't see, and could hardly get my breath. I dropped the brush and made a dash for the manhole. After getting some fresh air in my lungs and wiping my eyes, I thought I'd give it another try. Poking my head through the manhole was enough! Fumes got worse by the minute.

With all the work of preparing the surface, I didn't want to give up the job. What's more, I couldn't if I wanted to because the paint pail and brush were still at tank's far end. And those fumes kept me from going after them. Not having a gas mask, I thought I was licked. There are few business places open Saturday night at 8 pm in our town where you can pick up a gas mask.

Corner drugstore was open so I bought a pair of airtight diving goggles. Then I got a 15-ft length of garden hose. It sounds funny—but it worked. Wearing eye goggles and holding onto garden hose with my teeth, the manager fed hose to me and held other end out window for fresh air. In this way I finished the prime coat. We put on the final coat at midnight.

Monday morning the tank was dry and is now furnishing crystal clear water —thanks to a garden hose and water goggles. I know I should not have entered the tank without a gas or oxygen mask, but I did that very foolish thing. What would *you* have done?

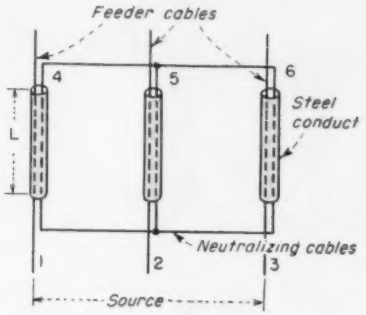
R J ANDERSON *St. Paul, Minn.*

Here's what I would have done . . .

TO TELL AC FROM DC (POWER, July 1954, p 129). How many people have stroboscopic vision to distinguish ac from dc? Here are several sure-fire methods:

Use a neon bulb to eliminate guesswork. Fuse pullers carried by maintenance men make this easy. Stick the line wires into a raw potato, or fill a glass full of water and put wires in it. Litmus paper is good, but you may have to buy it at a drug store. I'm sure POWER readers know of many other methods I haven't heard about—ones they have used.

C BACHMANN *Rego Park, N. Y.*



Single ac conductors in steel conduit

THREE STEEL CONDUITS, *sketch*, were installed for three conductor cables. Distance *L* was long and conduits were embedded in concrete. That made it impractical to increase their size.

Load conditions and circuit voltage finally tripled, making it impossible to use three conductor cables in same conduits. To solve problem, single conductor feeder cables were pulled into each conduit, plus cables 4, 5 and 6. These additional neutralizing cables were connected at ends of conduit runs. In effect we had a current transformer, with current flowing in conductors 1, 2 and 3. That set up a flux in each conduit which, in turn, induced a voltage in 4, 5 and 6. That created a current flow in these conductors in direction opposite to flow in 1, 2 and 3, and a flux opposing and practically neutralizing initial flux set up by flow in 1, 2 and 3.

Neutralizing conductors 4, 5 and 6 were made same area as 1, 2 and 3. Neutralizing effect by actual test indicates over 90% correction and no conduit heating or increase in voltage drop could be measured. Readers interested in checking question of induced voltages should read *Electric Power Transmission* (McGraw-Hill Book Co), second edition, pp 80-84, reference p 83.

C O VON DANNENBERG
Brooklyn, N. Y.

Cleaner flowmeter pens

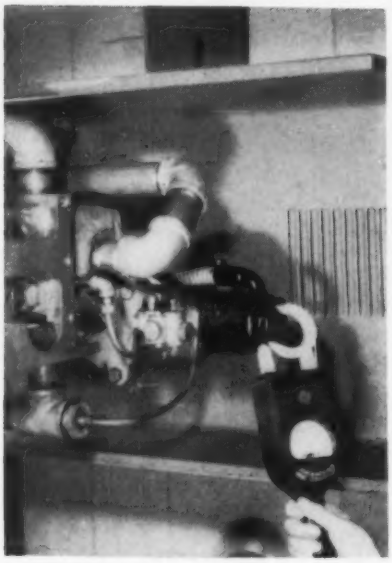
DRAFTSMAN'S INSTRUMENT ink remover is a handy aid in cleaning flowmeter and other control instrument pens. It rapidly softens all ink deposits and leaves the surface clean. A few grains of boiler chemical phosphate added to ink eliminates future pen clogging.

L W FITZPATRICK
Jefferson City, Mo.

(*Continued on page* 128)

More PRACTICAL IDEAS

Begins on page 126



Ammeter finds trouble

MAIN DIFFERENCE between the ordinary mechanic and operating engineer is that engineer must be an expert trouble shooter. He can't know too much about things chemical, mechanical and electrical.

In this age of complicated controls, many hidden devices give trouble. Any method that can be used to sectionalize the fault, without extensive testing or dismantling, saves time and money.

After years of search I've come up with this sure-fire way of knowing if an inoperative solenoid device or valve has a mechanical or electrical defect. If the entire electrical circuit is complete, deflections are given (1) on ac coils by a clip-on ammeter with open hook (2) on dc coils by a compass moved on outside. In both cases, the needles jump if the circuit is made on and off. In a fraction of a minute, I know if trouble is mechanical or electrical.

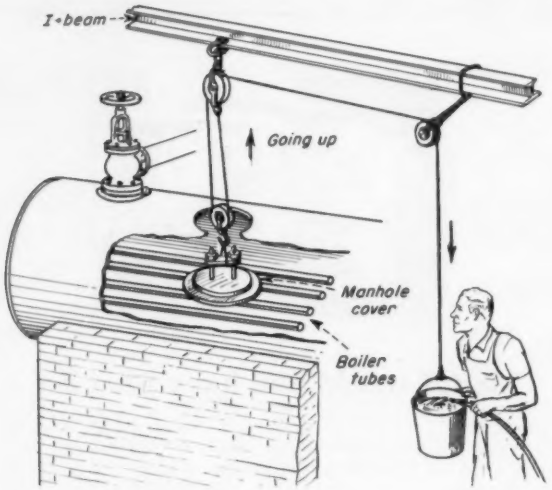
Anyone who has done any trouble shooting will appreciate the immense value of this speedy and simple check.

F J ARDOLINO *Brooklyn, N. Y.*

Handy welding tool

THIS TOOL for the pipe welder is a magnet. It quickly removes slag from mitered and saddle cuts in pipes. New, powerful Alnico magnets with their stronger capacity are easily inserted in the smallest pipe opening.

L W FITZPATRICK
Jefferson City, Mo.



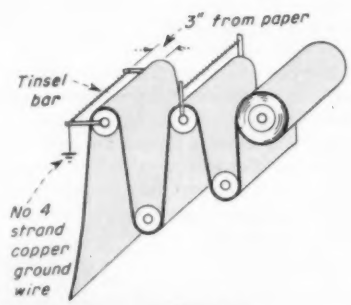
Here's your 'trick' of the month

MANHOLE COVER PLATES in steam drum of our 125-hp boilers are very heavy. They have two bolts and yokes. Plate is too heavy for one man to hold up in place and bolt with one hand while putting on yokes, washers and nuts. With no help to do the job this year, I had to figure a way to lift the plate myself.

Directly over manhole is a steel roof-beam. I drilled beam for wooden-pulley block, *sketch*, and hooked to cover plate resting inside on boiler tubes. Then I attached a large 10-gal bucket to other end near floor. Bucket was elevated above floor so cover plate would seat before can touched floor.

When everything was ready, I slowly filled can with water from a hose. Plate rose gradually to position inside boiler. All I had to do was put on the bolts, yokes, and tighten up nuts. Now this back-breaking job is easy.

A H PARKER *Peterborough, N. H.*



Tinsel bar collects static electricity

WE INSURED a firm who manufacture colored cellophane. They also print colored foil for Christmas wrapping. One day they were using a flammable solution to clean printing ink off rolls. Cellophane and foil had collected a good deal of static charge caused by friction of cellophane or foil running over rolls.

To lick their static problem, we had to find what caused the static. It could be (1) flow of steam used for drying ink, or flow of air from any opening in a pipe or hose (2) movement of nonconducting power or conveyor belts and (3) other forms of motion involving changes in relative position of contacting surfaces of dissimilar substances. One or both of these may be a poor conductor of electricity or nonconductor, causing a problem.

We found that cause was from item 3 as material to be printed ran over a number of rubber rolls. We stopped the static by installing tinsel bars, grounded to the machine frame with No. 4 standard copper wire, *sketch*. Tinsel thread-like wire picked up the static and transmitted it to machine's frame, which was grounded.

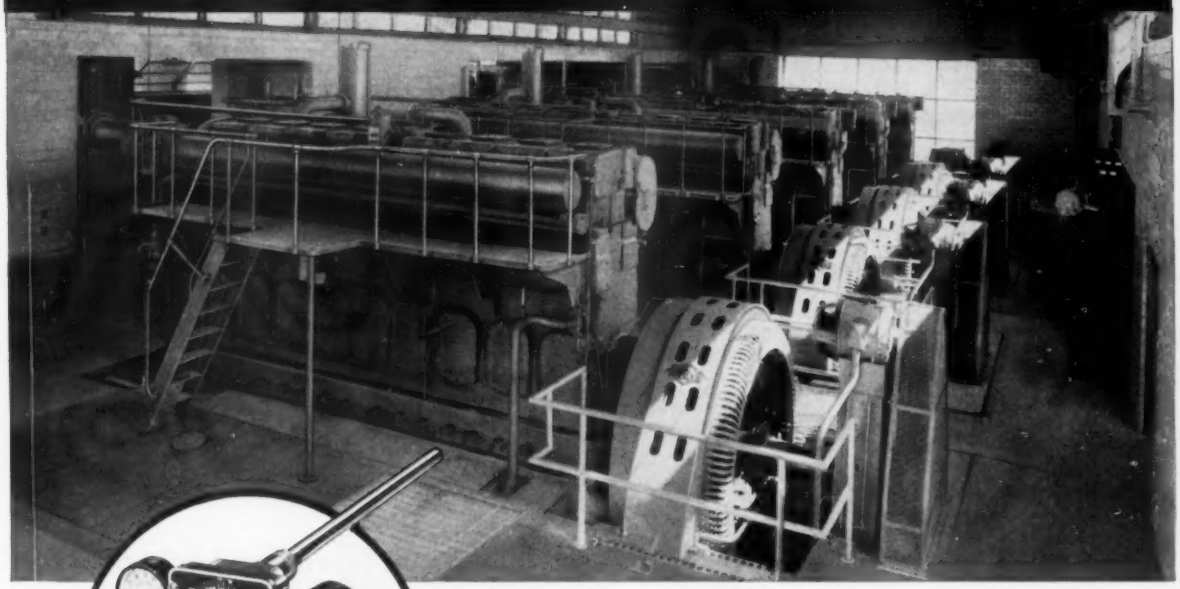
If the static accumulation had not been discharged, it could have caused a spark in mixtures of flammable vapors from cleaning material used on printing roll. Spark might then have caused a fire or even a damaging explosion.

P W OLSON *Mt. Vernon, Ill.*

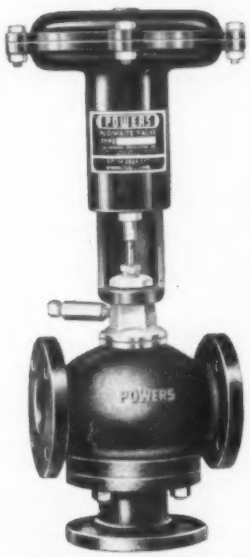
(*Continued on page* 130)

5 COOPER BESSEMER 1850 HP Supercharged DIESEL ENGINES

At WESTERN MINNESOTA POWER CO-OP., BENSON, MINN.



POWERS ACCRITEM REGULATOR
Time tested and proven dependable



POWERS FLOWRITE 3-Way VALVE

(b75)

Jacket Water and Lube Oil Temperature Controlled by POWERS

Here's another "Blue Ribbon" installation. Right engines for the job — right control for the engines.

Many temperature control problems can be solved best by POWERS versatile ACCRITEM-FLOWRITE system. Waste heat recovery, fuel and combustion air ratio-ing, and heavy oil preheat control are examples. Advantages of this pressure operated system are:

Closer Temperature Control because of greater valve power, adjustable sensitivity, and superior valve throttling characteristics.

More Reliable In Service because of fail-safe valve feature, over-range protection, and general rugged construction.

More Convenient In Use because of adjustable temperature control and indicating gages.

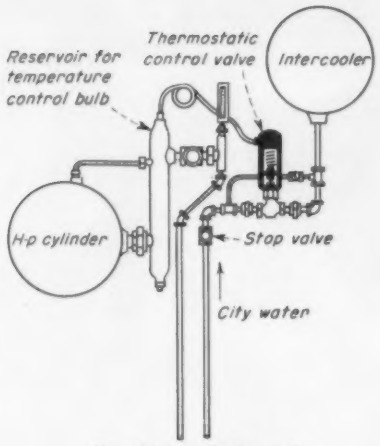
Easy To Install because of smaller temperature sensitive element; use of air, water, or oil as operating medium; copper tubing used between regulator and valve.

Reasonably Priced. Contact POWERS nearest office or write us direct for details on the ACCRITEM-FLOWRITE system of temperature control.

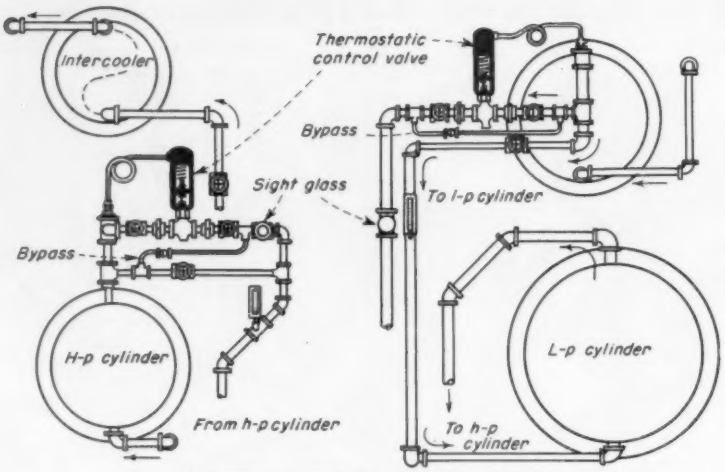
Established in 1891 • THE POWERS REGULATOR COMPANY • SKOKIE, ILL. • Offices in Over 50 Cities

More PRACTICAL IDEAS

Begins on page 126



For single cylinder and 2-stage compressor



High-pressure and low-pressure cylinder hookup for large compressors

How to eliminate water waste in your air-compressor hookup

WATER IS WASTED in manual-controlled operations, becomes costly, and compressor efficiency drops.

In places of high humidity or during summer, excess water causes sweating in cylinders, intercoolors and aftercoolers. Continuous operation then may ruin cylinders by washing oil film off their walls, causing friction, overheat.

Condensation creates an oily emulsified-sludge from cylinder walls, passes to traps, then sludge gums trap orifices. Air flow deposits oil-contaminated sludge in receivers. Excess vapor or condensation passes to plant tools and processing, causing costly shutdowns.

You can control this by using thermostatic control valves installed at strategic locations. Temperatures are controlled in both water and air, water flow is maintained.

In one large plant where compressed-air capacity ran into millions of cubic feet per day, we had to use booster pumps for city water to boost pressure to plant. Air load fluctuated, as did water pressure in jackets. That brought about conditions that made it necessary for compressor operators to be constantly on their toes. Temperature control-valves were installed, resulting in lower maintenance and better efficiencies, besides saving city water.

You can use waste water from compressors and aftercoolers for plant sanitary uses, or pump to fire-protection tanks. In one plant water was used twice for a battery of compressors after heat exchangers cooled the water. In another plant, water from compressors passed to the open feedwater heater, and was used in boilers. One plant used water to condense steam, overflow being pumped to fire-protection tanks.

J M GORRIE *Euclid, Ohio*

One-hand vise shear for rod and sheet

THIS HANDY SHOP-MADE TOOL will repay you for all the trouble of making it. I used an old 14-in. flat file from which I ground off the file cuts, then annealed it and put in bolt hole. Vise jaw was cut out to shape shown on a metal-cutting band saw, and the tabs and tongue formed. After grinding cutting edges I tempered the tool.

When it is completed as in sketch, and gripped in bench vise, you can manipulate work with one hand and cut with the other. Either rod or sheet, limited, of course, to gages that can be handled, is easy to cut now.

This shear can be made from scrap in mechanic's spare time, costs little.

C H WILLEY *Penacook, N. H.*

Now, silent sound makes metal surfaces cleaner

TOO OFTEN soil removal from metal surfaces is an expensive hand-wiping operation. By converting electrical energy to sound energy both hand wiping and soil are eliminated.

Hydraulic valve lifter assemblies for a modern V-8 automobile engine are an example of ultrasonics' effectiveness in cleaning metal parts. Vapor-spray degreasing plus ultrasonics removed 15 times more surface soil than the method used in one plant prior to test. As a last stage, where present methods are not adequate, the ultrasonic technique yields the best results in the history of industrial cleaning and there is no mess.

Courtesy, Detrex Corporation, Detroit, Mich.

which impulse for you?

STANDARD

The standard YARWAY Impulse Steam Trap serves all normal trapping requirements. Factory set to operate without adjustment at all pressures from 20 psi to 400 psi (Series 60) and 600 psi (Series 120). For pressures below 20 psi, merely remove split washer.

Numerous advantages like:

small size
quick heating
steady temperatures
stainless steel construction
one moving part
non-freezing
low cost

More than 900,000 used throughout industry.

Write for YARWAY Bulletin T-1740.

HIGH PRESSURE, INTEGRAL STRAINER

YARWAY Integral Strainer High Pressure Impulse Steam Traps operate on some of the highest pressure steam lines in the country. Same operating principle as the standard YARWAY Impulse Trap. Strainer built into trap.

Ample capacity when system is being "warmed up"—yet will handle relatively small amounts of high temperature condensate without losing prime. Six sizes—½" to 2". Pressures to 1500 psi (flanged ends) or 2500 psi (welding ends).

Write for YARWAY Bulletin T-1740.

YARNALL-WARING COMPANY
100 Mermaid Avenue, Philadelphia 18, Pa.

YARWAY

impulse steam traps

YARWAY Impulse Steam Traps and Fine Screen Strainers are stocked and sold by more than 250 convenient local distributors. Write for name of one nearest you.

PLANT PROBLEMS . . . *helpful info from readers*

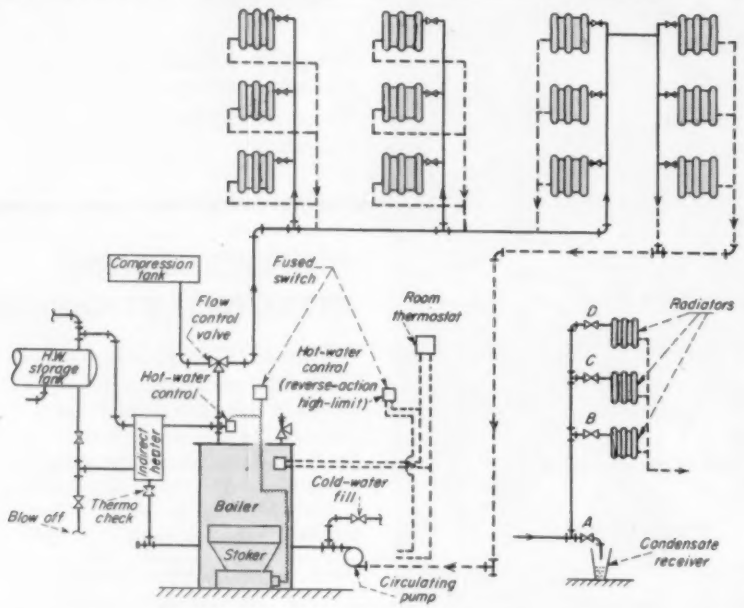
How is heating system best balanced?

HERE ARE THE FACTS: We have a 20-story apartment building with a forced hot-water heating system. Some apartments are too hot, some too cold. Hot-water temperature and flow are more than adequate and radiators appear in working order.

I think the system needs rebalancing. Each riser has a balancing valve at its heel and every convector has a shutoff valve in its supply and return lines.

What's the best procedure for balancing flow? How can we check to see that flow is right in the risers? ***WS, June Power***

Here are the answers



TYPICAL ARRANGEMENT of a forced-circulation hot-water system appears in the sketch. With this design, returns from each radiator are piped to the hot-water supply of the following units, with the total flow being pumped through an indirect heater into a hot-water storage tank after passing through the boiler.

Compression tank maintains nearly constant pressure on the system at all times. Automatic valves control flow according to system heat demand.

First step for *WS* is to check the radiating surface in each apartment to see it is sufficient for the heating load. Remember, size, configuration and exposure of each room influence its heat requirements. With these data on hand, *WS* can estimate the required hot-water flow and check to see if existing pipe sizes are satisfactory.

Knowing the available pump head and pipe sizes for each unit, *WS* can estimate the flow quantities in his system. Comparison with the flow's earlier estimate permits him to find the radiators not receiving the needed flow.

Adjust balancing valves on risers containing radiators with the wrong flow. This is a trial-and-error solution that may or may not produce the desired results. If some areas are still cold, use a pump having a higher head or install larger pipes. Running new pipes is costly; a higher head pump is, therefore, probably the best solution.

Check riser flow by opening drain *A* at base (right sketch) and closing valves *B*, *C* and *D*. Collect flow in a receiver during a measured period and weigh. Average flow in lb per hr is computed and compared with required flow.

H B Wayne *Brooklyn, N. Y.*

MOST HEATING SYSTEMS, well designed or otherwise, are somewhat out of balance because the conditions the designer envisioned on paper do not exist exactly on the finished job while it operates. In an unbalanced system the piping resistances are not equalized and short circuiting occurs.

Flow can be balanced with regular square-headed cocks, on a trial-and-error basis. Best results are secured when the cocks are installed in return lines. Another simple alternative is to install orifices in branches to individual convertors and radiators. Purchasing orifices is simpler than making them yourself. Give the manufacturer the Btu requirement, water temperature and pipe size. With this information he will furnish the correct orifice and tell you the friction at different flows.

Keep flow velocity under 4 ft per sec. Avoid extremely low velocities and abnormally high. Choosing too high a velocity can lead to noisy operation and excessive friction in small lines.

See that water temperature is at right level. This insures correct heat release and prevents scale formation in the system. Bleed air from top of system at the end of every heating season. Keep all pipes filled with water during summer. Be sure to apply some rust inhibitor to prevent internal corrosion, which can lead to heating headaches in the winter if attack is serious.

L W Fitzpatrick *Jefferson City, Mo.*

CHECK FEEDER MAIN to see it is large enough for building load and free of obstructions. See if the same rooms and radiators are cold every day of the year. If the cold complaints always come from the same area, it may be easier to spot and cure the trouble than if they shift from day to day.

Air binding of radiators or convectors is a common cause of heating complaints. So be sure to bleed units in cold apartments. Do the same for the return lines serving these apartments. An air-bound return can completely stop or seriously reduce water flow from the radiator, leading to heating complaints.

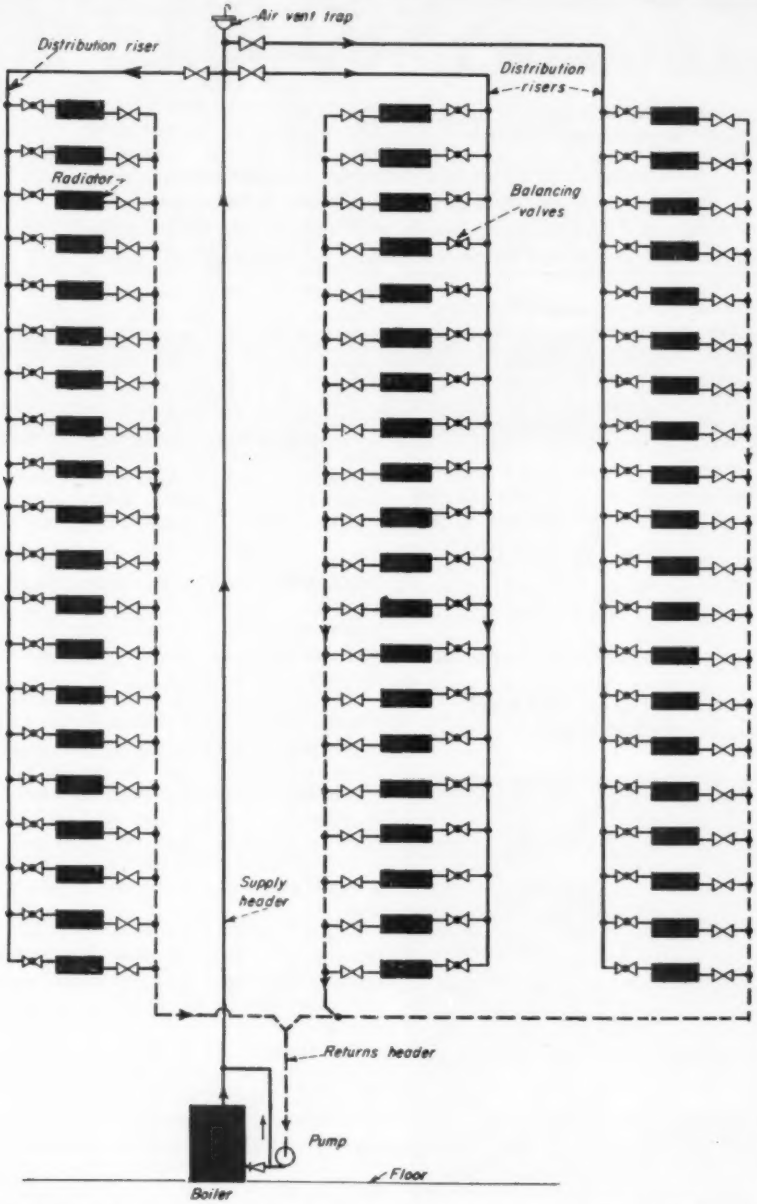
C G Howarter *Canton, Ill.*

FIT CONTROL VALVE for each apartment. Have valve operated by apartment thermostat to automatically control water flow into the radiators or convertors. Or variable orifices can be fitted to the heel of each riser to control flow.

Melvin Evans *Minneapolis, Minn.*

on heating system and stack corrosion

TYLER HICKS, *Associate Editor*



INSTALL balancing valves at each radiator inlet to balance a system as large as the ones *WS* has in mind. Using valves only at each riser's heel, as in his system, doesn't give needed control.

Sketch shows an overhead 2-pipe forced hot-water system suitable for a 20-story apartment building. Distributing flow from top of building to various zones helps improve balance. On extremely cold days, open riser isolating valves at top of building enough to permit equal flow to all zones. Once valve opening is set lock the valves in position.

Air trap at top of supply header allows venting and air removal from piping as well as from each radiator.

A good balancing valve is a standard packless type combined with a cartridge or tube having multiple orifices. Tube is designed to give the needed frictional resistance at the radiator inlet.

Valve manufacturer will design the internal tube if data are supplied on unit arrangement, size and steam needs. Using this type valve eliminates troubles.

A J BREUGELMANS *New York, N. Y.*

(*Continued on page* 134)

YOUR SEPTEMBER PROBLEMS

1 Why does water leave gage glass?

We have a 4000-lb-per-hr oil-fired firetube boiler in our plant. Until three weeks ago it ran fine.

Lately, though, water in the gage glass drops from sight once a day. This usually happens approximately two hours after the start up.

We normally carry two to four inches of water in the glass. No change appears in boiler load either before or after the water disappears.

We've checked the column for dirt and thoroughly cleaned it. Draining the boiler and checking the feed pump and the controls did not cure the trouble.

Why does water leave the gage glass? How can we prevent this condition? Is it unsafe?—*RH*

2 How do we raise motor speed?

We have a 12-pole 440-v 600-hp slipring motor driving a hoist. We'd like to increase the motor speed slightly, let's say 20%.

I have figured a way to change the stator connection from 12 to 10 poles by leaving only a few dead coils evenly spaced around the stator. Must the rotor connection be changed to 10 coils as well?

If the rotor should have a wave winding, could we do this by changing the rotor connections and using the same windings?

So my question comes down to essentially this: Is it absolutely necessary for the rotor of a slipring wound-rotor induction motor to be wound for exactly the same number of poles as the stator for satisfactory operation? If so, why?—*BB*

Will you help readers who sent problems? Extra pay for photos, sketches.

More PLANT PROBLEMS

Begins on page 132

How can we stop stack corrosion?

HERE ARE THE FACTS: Our 15-yr-old steel stack collapsed during removal for replacement. Checks showed the ¼-in. mild-steel plates had thinned to 1/16 in.

We could have avoided the inconvenience of the collapse by removing the stack three years sooner. Or we could have left it in service until its own weight caused it to fall. Which is more economical?—*CW, June Power*

Here are the answers

NONMETALLIC STACK—hollow tile with concrete fill, brick or reinforced concrete—will eliminate the corrosion problem. But each type needs a larger foundation than a steel stack, increasing job cost. Nor would stack be maintenance-free because every material presents some problems.

Regardless of the type of nonmetallic stack chosen, ladder-rung loops anchored in masonry require periodic inspection. There may be some corrosive action at these loops. Also, masonry may suffer a fall in its holding power after the lapse of a number of years.

When population growth in the plant area is large, stack height may have to be increased. This can be costly if foundation changes are needed. Higher stacks have greater wind loads which are transmitted to stack foundation.

Steel stack is better for *CW's* job because a smaller foundation may be used, ladder rungs are permanent and overall cost lower. Using a straight stack instead of a tapered one saves about 10% on first cost.

Low chrome-copper alloy steel is a suitable corrosion-resistant material. Its higher strength permits use of plate thicknesses down to 5/16 in. Additional cost of alloy is only about 5%.

Steel-stack maintenance costs are about the same as with other materials. Outside must be painted about every five years to insure a nonporous protective coating for the metal.

Coating or lining inside of stack reduces corrosion during load swings when flue-gas dewpoint is reached. Lining protects inner surface of stack from extreme temperature changes, reduces erosion and corrosion, and allows use of higher stack temperatures because the cold exterior produces an insulating effect. Higher gas temperature improves discharge and dispersion.

Planned removal is the safest and most economical way of getting rid of a severely corroded stack. There are contractors who specialize in this work.

A J Breugelmans *New York, N. Y.*

INSULATING LINING often reduces or eliminates corrosion in metal stacks, particularly with fuels other than natural gas and with moisture conditions that are not extreme.

One insulating lining is made of corrugated asbestos felts built up to form a cellular sheet. Treating with a vitrifying solution increases the resistance of the sheets to moisture, enabling them to withstand temperatures to 700 F. They are made flat or curved, to fit inside the stack. All joints between sheets must be cemented to reduce vapor penetration.

Angles welded or bolted to stack interior support the lining. Interior metal surfaces are coated with an asphaltic protective material before the lining is applied.

Insulation reduces stack heat loss in cold weather, minimizing moisture condensation. After shutdown, stack interior remains warm enough for incoming air to carry off any moisture residue. *CW* should be especially careful to obtain a recommendation from the insulation manufacturer before installing this type of lining. Then he'll be certain of obtaining the desired results.

E H Thring *Toronto, Canada*

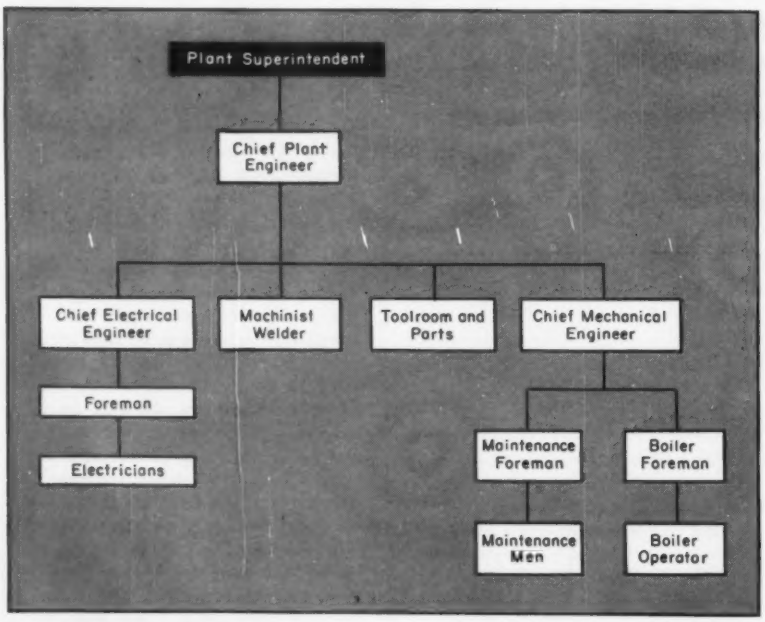
NEVER WAIT until stack falls. It may conk someone on the head or fall across the plant, causing a costly shutdown. It is far safer to replace when inspection shows stack is badly corroded.

Scrape interior of a steel stack at frequent intervals and paint with a suitable temperature-resistant paint.

(*Continued on page* 136)

For you two new problems, turn to page 133

Another answer to May question, "How can we set up our plant jobs?"
For the other letters from readers, see the August issue



QUESTION: *I need a chart to organize a medium-size manufacturing plant, with mechanical, electrical power-plant crews. Plant has a number of usual auxiliaries. What's best way to arrange for operation, maintenance?*

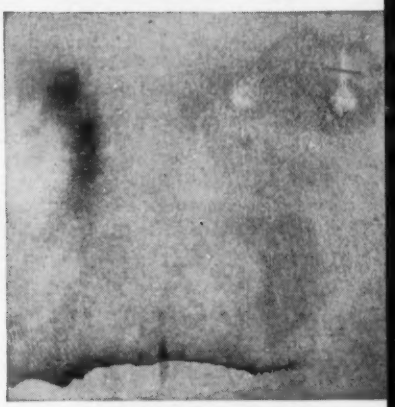
ORGANIZATION shown should be satisfactory if it is changed to suit the conditions in *CC's* plant. Much depends on the number of shifts and the number of days the plant operates every week.

D L Cochrane *Cambridge, Minn.*

HOW NEW SOLNUS OILS HELP MAKE AIR COMPRESSORS FIRE SAFE

Actual photographs show amounts of carbon residue left after dropping equal quantities of Solnus and two other oils on steel plates and baking in a closed oven at 500°F for 24 hours. The three oils all had viscosities of 300 SUS at 100°F.

SEE HOW CLEAN SOLNUS LEAVES HOT METAL



New SOLNUS Oil 0.9%

Typical Naphthenic Oil 5.5%

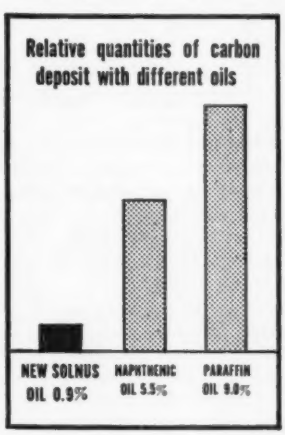
Typical Paraffinic Oil 9.0%

The biggest cause of air compressor fires or explosions is carbon formation on valves and in discharge lines. The best way to avoid these risks is to use the lubricating oil having the lowest tendency to form carbon.

New Solnus Oils have been proved ideal for air compressor use. The minute amounts of carbon that will form are of a fluffy nature; so they blow off quickly and do not build up. Thus the danger of fire or explosion is largely removed.

Solnus Oils have other important advantages, too. Your compressors need cleaning less frequently. This reduces maintenance costs. Shutdowns are less likely. Plant efficiency is increased.

Solnus Oils are also ideal for circulating systems, hydraulic systems, gear boxes, and general lubrication of your industrial equipment. They simplify your storage problems by doing with *one oil* many jobs that would otherwise require *several*. Combine their ability to protect metal parts against corrosion, their resistance to oxidation, and their moderate price and you see how Solnus Oils give you "more lubrication per dollar."



Let us send you our complete technical bulletin on Solnus Oils. Just write Dept. P-9.

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More PLANT PROBLEMS

Begins on page 132

Keep stack interior and base clean and free of flyash and soot. Using high-moisture-content fuels hastens corrosion in unprotected stacks.

Lined stacks are efficient as chimneys and show good corrosion resistance with little gas leakage. Apply an alumnite cement and suitable aggregate with a gun in a 2-in.-thick layer over suitable mesh held to stack by welded studs.

A good lining correctly applied gives better dispersion, minimizes strain in cold weather and ends most corrosion worries. Be sure to protect stack outlet with a cover during long shutdowns because moisture entering from the atmosphere may lead to severe corrosion.

L W FITZPATRICK
Jefferson City, Mo.

DON'T WAIT until stack falls. It is unsafe and uneconomical because someone may be killed or the boilers may have to be shut down for weeks.

Sulfur compounds in flue gas unite with moisture to form acid when gas temperature falls below the dewpoint. The acid is the major cause of corrosion. Often greater corrosion occurs at stack outlet because gas temperature is lowest there. Vanadium pentoxide, met in oil fuel, may also cause corrosion in steel stacks.

Lining stack interior with gunite or another refractory is usually the best means of reducing corrosion. Lining cost depends on stack diameter and height, but it is usually cheaper than alloy or carbon-steel construction.

H B WAYNE *Brooklyn, N. Y.*

MANY STACKS collapse without great damage. But it still isn't safe to wait until this happens before removing a defective one. Lining stack with a thin layer of castable refractory held in place by welded anchors is effective in reducing corrosion.

Consult refractory manufacturers to find total cost of lining. Divide this by expected life of stack to determine extra annual cost of lining.

IRA A BUTCHER *Cincinnati, Ohio*

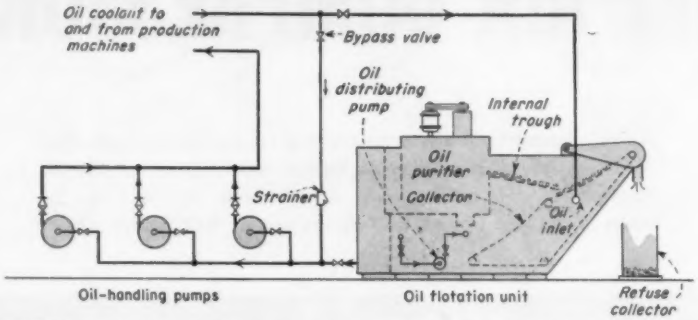
SAFETY is a factor that cannot be expressed in terms of dollars. So allowing a stack to corrode until it falls is foolish because of plant, personnel hazard.

MELVIN EVANS *Minneapolis, Minn.*

WROUGHT-IRON STACKS last two to three times as long as ordinary steel. But first cost is about 30% higher. Higher cost should be compared with total cost of a lined steel stack.

(*Continued on page* 200)

Two more answers to May question, "How can we protect coolant-oil pumps?"
For the other letters from readers, see the August issue



QUESTION: *Three months ago our metal-working plant set up three 100-gpm centrifugal pumps to handle coolant oil. How can we reduce excessive wear in casings, impellers, seals, wearing rings? Can we treat oil before it reaches pumps?*

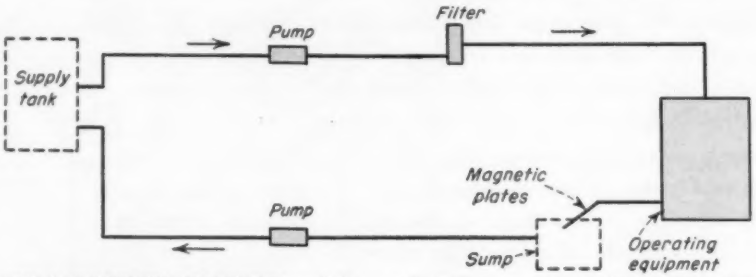
METAL CHIPS cause excessive internal wear in *MV's* pumps. If he continues to run with his present setup they will need new casings within a short time.

Sketches and photo show a good hookup for an oil flotation unit. The bypass, having a fine-mesh strainer or filter, is used only during outages of the flotation unit when coolant flow is needed.

Oil entering the flotation unit passes to the purifier section. Here it is churned into a froth in which the metal solids are held in suspension. From this section the froth goes to the trough and onto a moving collector. The collector discharges to a floor-mounted receptacle. Clean oil flows to the outlet of the unit, and then to the circulating pumps.

Units of this design are completely automatic and need no filters. This cuts maintenance time and labor. The low operating cost, plus decreased pump maintenance, makes this unit pay out in a short period.

A J BREUGELMANS *New York, N. Y.*



USE A MAGNETIC SEPARATOR and the hookup shown in the sketch. It eliminates troubles in the coolant pumps. *MV* can reduce scale, acid and asphalt products that cause sludge by using 1 qt of regular fuel-oil additive for each 100 gal of oil coolant.

While oil purifiers remove most heavy metal chips, magnets and filters are needed to completely remove all metal and abrasives without also taking out any additives that are being used.

At temperatures of 175 F, or less, coolant oils have an almost indefinitely long life. If temperature exceeds this value, use watercooled oil cooler in system.

Ask machine operators to cooperate by keeping dirt away from the oil streams in their machines. Check the oil regularly. You can often detect grit by feeling a smudge of the oil. Chemical changes may be indicated by odor and color changes.

Check pump operation at regular intervals. Chips, lint and other contaminants may jam rotating and stationary parts. Use only a safe solvent to remove gums, sludges and varnishes from the pump impeller. Don't use files, emery cloth or steel hammers—you may damage the impeller.

Be sure the oil isn't too heavy. Too high a viscosity can lead to many troubles. Because the oil absorbs oxygen during passage through the system, an additive is needed to prevent sludge and gummy deposits. We usually use 200-mesh wire filters in our system, instead of 100-mesh. The finer mesh really pulls out the dirt from the oil.

L W FITZPATRICK
Jefferson City, Mo.

"FLEXITALLIC—DO NOT SUBSTITUTE"

Four words . . . but every time they appear on an order, Flexitallic salutes an engineer who has joined the crusade for one standard of quality in gasket construction.

Flexitallic Spiral-Wound identifies the original spiral-wound gasket—the standard of quality in high-pressure, high-temperature seal for more than 40 years.

Spiral-wound is the proper designation of a gasket that compresses like a spring to make an effective seal, compensates for unpredictable joint stresses, and then rebounds when the bolt load is relaxed.

Flexitallic Gaskets are exclusively spiral-wound, the uniquely resilient construction pioneered by the Company in 1912.

Each Flexitallic Gasket is engineered to meet specific conditions of thermal and physical shock, corrosion, vibration, weaving and unpredictable joint stresses. Spirally-wound V-crimped plies of required metal with alternating plies of proper filler results in a resilient gasket having characteristics of a calibrated spring.

Flexitallic Gaskets are at highest efficiency when bolted up cold at a predetermined load. For all pressure/temperature ranges from vacuum to 10,000 lbs., from extreme sub-zero to 2000° F. For all standard joint assemblies. In four thicknesses for special requirements: .125″, .175″, .250″, .285″. In diameters to 84″ O. D.

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ARGUMENTS

Want to start something? Like to have your say about any article in Power? This department invites all comments

Give me protection against flying injury!

REFERRING TO THE ITEM about safety hats, p 148, June POWER, I think the purpose of a safety hat is protection. Therefore, it should be worn for the utmost shielding from injury. The only person who can determine that is the man wearing the hat. That goes for any kind of headgear—cap, felt hat, straw hat, bandanna or anything else.

The man on the cover of the March issue has no doubt found that flying particles are most apt to come from the front, and that the wide brim will give more protection to his face and eyes than the narrow brim.

On the other hand, if the back of his neck were more vulnerable, he would turn the wide brim to the rear, see sketch.

Herman Phelps can wear his hat any way he pleases, but I will decide for myself which way best protects my head.

H T LIVINGSTON
Los Angeles, Calif.

How we simplified smoke measurement in '25

IN YOUR MARCH ISSUE, p 90, you described POWER's new MicroRingelmann chart. Good idea. Here's a report on an earlier effort in the same direction:

You undoubtedly recall the Roberts smoke charts, which are (or were) circular cards bearing radial lines providing the proper percentages of black and white. These cards, when spun rapidly, give the desired gray tones.

Roberts made little cards, about 3 in. diameter, to be spun at arm's length, with perhaps a wire nail for pivot. Larger cards, about 8 in. diameter, were intended for some of the more elaborate arrangements.

Some time before 1925, we in Detroit Edison Co mounted a Roberts disk on a desk fan motor, spun it on the roof in good sunlight, and photographed it. The photographers made prints of varying density, which we matched against the spinning disk. The three gray tones that got majority vote for No. 2, 3 and 4 were turned over to our paint shop, where matching paints were made up and applied to small metal strips that could be easily carried.

These were issued to our plant men to be used to estimate smoke density.

C H BERRY *Cambridge, Mass.*

EDITOR'S NOTE: *Undoubtedly the Roberts spinning charts are the most precise way of matching Ringelmann shades in a chart that will fuse close to the observer. The substantial width of lines insures high precision in the "percentage black," and spinning the card gives perfect fusion.*

It is always good to hear from Harold Berry. He is Gordon McKay Professor of Mechanical Engineering at Harvard University. After leaving Detroit Edison he was a member of the POWER *editorial team for a while before going to Harvard.*

No hard-and-fast rule on way to wear hat

I SEE THAT a reader questions the way to wear a "hard-boiled" hat (p 148, June POWER). I have been in safety engineering since before the hat made its debut in industry, so I know there is no hard-and-fast rule on the subject.

At one time, only the hat itself was on the market, and the wide brim was most frequently worn in the back. This early hat was largely used in underground operations, where workers need protection against rock falls. Wearing the longer brim in the back keeps small, sharp rock particles off the back of the neck.

For wet locations, this style keeps cold trickles of water off the bare back. And the short brim in the front makes it easy to hang up or detach cap lamps. This set the convention of wearing the long section in the back, and when surface workers adopted the hat they merely followed the custom without question.

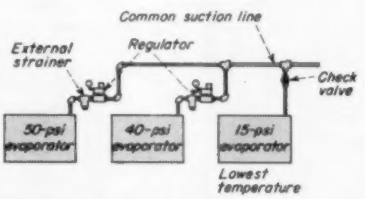
PAUL ZIEMKE *Oak Ridge, Tenn.*

Put wide brim in the back

IN JUNE ARGUMENTS, Herman Phelps takes issue on the right way to wear a safety hat. He says the March 1954 cover shows someone wearing a safety hat with the wide brim in the front, while it should be the other way round.

He's right. The correct method is to wear the wide brim in the back. If a member of POWER's staff tries wearing a safety hat with the wide brim in front, he will soon find that it's uncomfortable.

H B WAYNE *Brooklyn, N. Y.*



Claims installation is wasteful

THE MULTIPLE EVAPORATOR installation shown on p 118, September 1953 (sketch above), might be satisfactory for very small units, but it's wasteful in large systems.

I am sure that looking at the Bureau of Standards ammonia tables will convince anyone of the loss by operating as this sketch suggests.

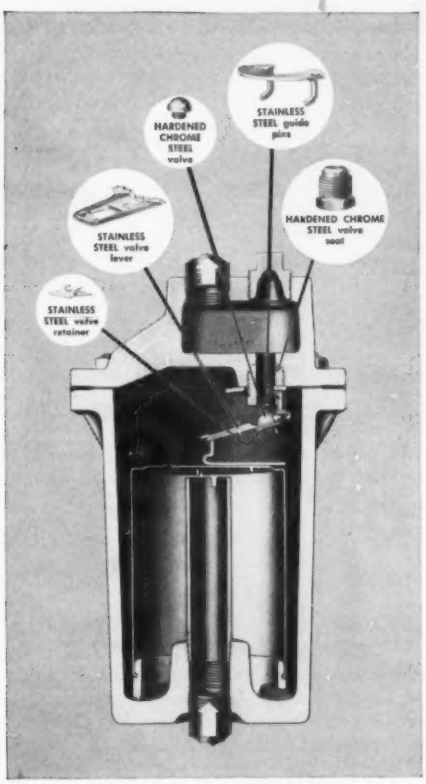
MARION JONES *Syracuse, N. Y.*

You will always get better results by putting a Steam Trap on each Steam Coil, Chest or Unit

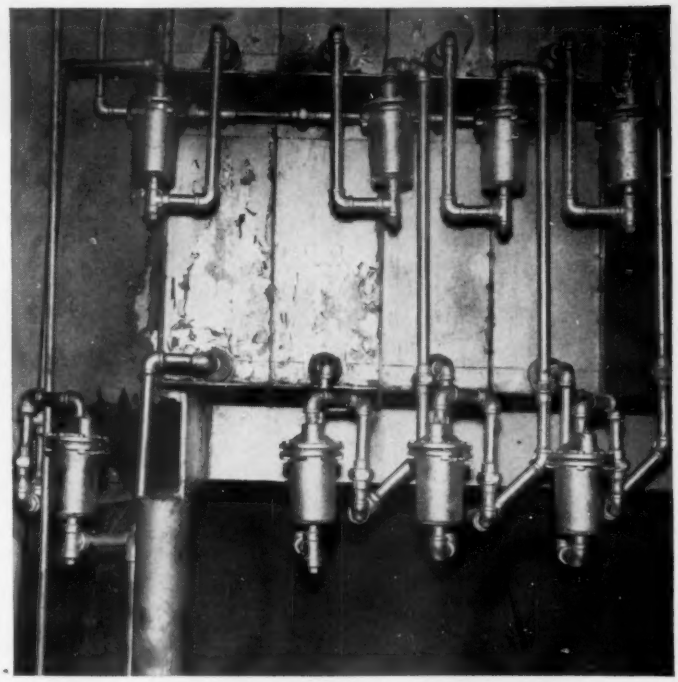
EXAMPLE

Dryer Temperatures at
Guelph Creamery, Guelph, Ontario.

WITH GROUP TRAPPING (5 steam traps for 10 coils)	225°F
WITH BLOW-THROUGH (no steam traps)	250°F
WITH ARMSTRONG UNIT TRAPPING (10 traps—one on each of 10 coils)	309°F


HARDENED CHROME STEEL valve
STAINLESS STEEL guide pins
STAINLESS STEEL valve lever
HARDENED CHROME STEEL valve seat
STAINLESS STEEL valve retainer

One of the big advantages of Armstrong traps is LOW MAINTENANCE. Mechanisms in low and medium pressure traps identical in design, workmanship and materials to those in 900°F, 900 psig traps.



The example at the upper left is simply one of thousands that bear out the benefits of "Armstrong *Unit* Trapping".

When you analyze it, the reason is quite obvious. No two steam coils, chests, chambers or machines will condense steam at exactly the same rate under operating conditions. There is a greater pressure drop in the units that condense the fastest. Steam will backflow through a common drain line from a higher pressure unit to a lower pressure unit. This blocks off flow of air and retards condensate flow from the lower pressure unit. On the other hand, if you separate each unit with its own trap, that can't happen.

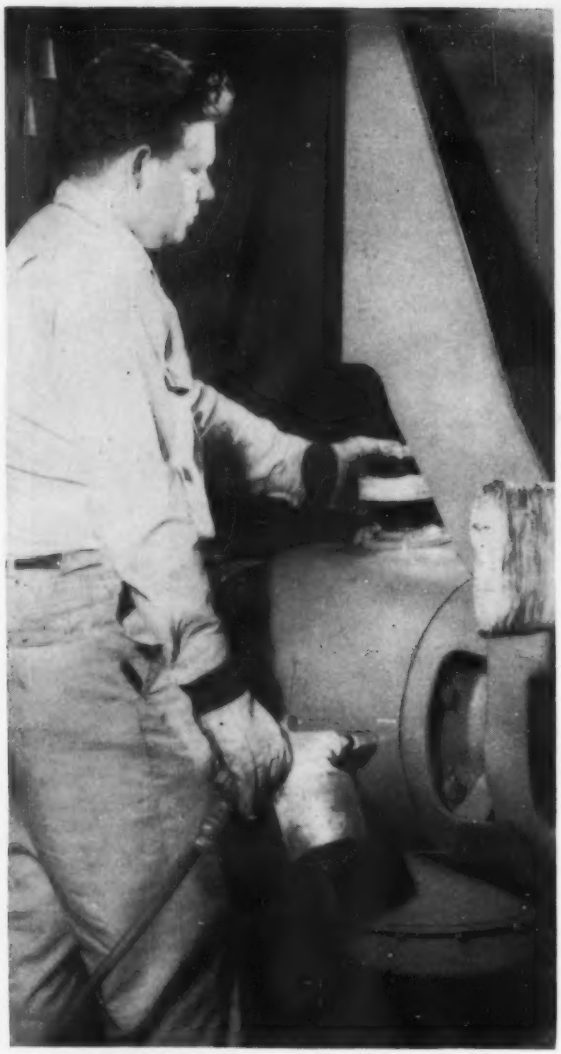
You will *always* get higher temperatures and lower production costs with unit trapping. Ask your Armstrong Representative about it, or write:

ARMSTRONG MACHINE WORKS
812 Maple Street, Three Rivers, Michigan

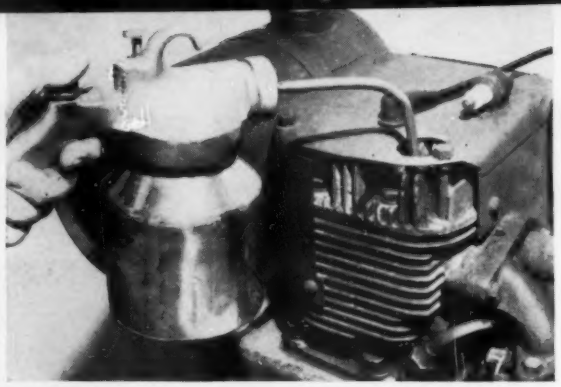
FREE—STEAM TRAP BOOK

If you don't have a copy of the 44-page Armstrong Steam Trap Book, we'll be glad to send you one. No obligation.

ARMSTRONG STEAM TRAPS



GEAR-REDUCING BOX of this fluid mixer gets a shot of corrosion inhibitor that is propelled by 80-psi nitrogen from hose



CYLINDERS of engines, compressors, etc, are kept rust free by injecting this inhibitor before the machinery is shipped

HAND TOOLS or any ferrous or aluminum parts and equipment can be coated, then used without coating again for some time

FOR SPRAYING, mix powder with alcohol. About 1 gram of chemical shown is enough to protect 1 sq ft of enclosed surface

HOW TO

protect against corrosion

Courtesy, Shell Oil Company

► NEW CRYSTALLINE amine nitrite compound, known as VPI, prevents corrosion under high humidity in aircraft and other internal-combustion engines, tools and dies, sand-blasted parts, continuous strip steel, antifriction bearings, stampings and forgings, sheet-metal components and parts to be plated, machine and other tools. Also used as rust inhibitor in hydraulic fluids and in water-soluble paints for general-purpose industrial coatings.

Portions of this compound volatilize rapidly to prevent rust almost immediately, claim the makers. At the same time, some constituents evaporate more slowly, for longer-lasting protection.

This new white powder also flows more freely. Because it is as fine as talcum, it does not clog a flocking gun, is easily applied with squeeze bottle, salt shaker, or similar device. Where spraying or dusting is impractical, dissolve powder in alcohol and apply.

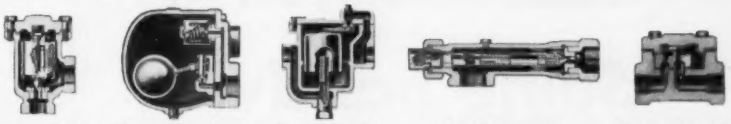
You don't have to apply this powder directly to surface. Dropped into enclosed space it forms vapors that penetrate hard-to-reach areas and condense on surfaces. Minute crystalline film doesn't have to be removed before equipment is placed in operation, as with grease or petrolatum. Small quantities give complete protection in shipment or storage, or between processing steps. Small items like tools can be used, then replaced without being sprayed again.

SARCO

A complete line of steam traps, temperature controls & heating specialties

Here are a few

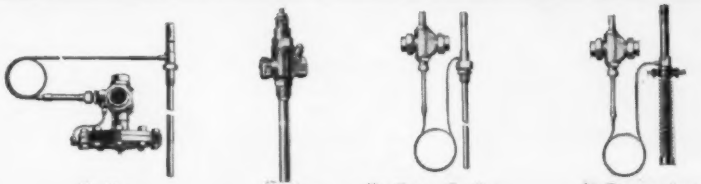
STEAM TRAPS



Thermostatic | Float-Thermostatic | Camlift Bucket | Liquid Expansion | Thermodynamic

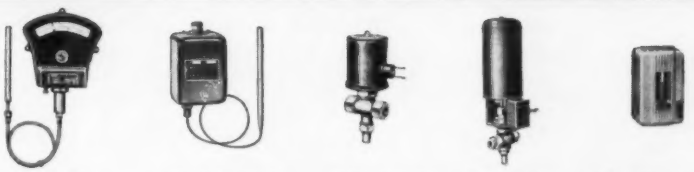
The right trap for each job . . . Only Sarco offers 5 functionally different types — not variations of one type!

TEMPERATURE CONTROLLERS



Heating | Cooling | Heating or Cooling | Air Temperature

ELECTRIC-THERMOSTATS AND VALVES

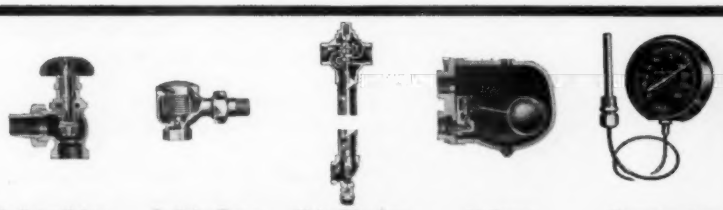


Indicating | Non-Indicating | Solenoid Valve | Motor Valve | Room Thermostat

AIR ELIMINATORS AND STRAINERS

Air Eliminators | Strainers | Scraper Strainers

OTHER HEATING SPECIALTIES



Radiator Valves | Radiator Traps | Water Blenders | Air Traps | Thermometers

BULLETINS

Send us data concerning your installation; we'll gladly send you bulletins and case histories. Sarco Company, Inc., Empire State Bldg., N. Y. 1, N. Y.

SARCO SAVES STEAM

2071-B

HEADWORK

PHIL SWAIN BRINGS ENGINEERING THEORY DOWN TO EARTH

Combustion Facts-7:

Some handy rules of thumb

► THE PRECEDING ARTICLES in this series set down some of the fundamental chemistry of combustion—basic facts every power engineer should understand. Yet it is only fair to admit that there are some handy short cuts that will save you a lot of pencil work and give answers close enough for many purposes.

So here are my rules of thumb. In addition, you will need to know the general class of fuel, the heat value, moisture content and ash content. These last two won't affect your answers much, so can be guessed at if you don't have actual laboratory data. You should also have the temperature and CO_2 content of the stack gases, and the room temperature.

My rules are given at the right. Here is how to use them for the following case:

Fuel—bituminous coal:
- 13,000 Btu per pound as fired
- Moisture, 5%
- Ash, 8%

Flue gas:
- Temperature, 520 F
- CO_2, 12%

Room temperature, 80 F

Here are steps:

1. Theoretical air is $0.74 \times 13 = 9.6$ lb per lb coal
2. Water produced by combustion is $0.025 \times 13 = 0.33$ lb per lb coal
3. Total moisture in flue gas is $0.33 + 0.05 = 0.38$ lb
4. Theoretical CO_2 is 18.5%
5. Ratio actual air to theoretical is $18.5 \div 12.0 = 1.54$
6. Total weight air supplied is $9.6 \times 1.54 = 14.8$ lb per lb fuel
7. Percentage excess air is $100 \times (1.54 - 1) = 54\%$
8. Dry gas per lb fuel is $1 + 14.8 - 0.38 - 0.08 = 15.4$
9. Stack loss in dry gas is figured this way: Temperature difference is $520 - 80 = 440$. Heat loss is $440 \times 0.24 \times 15.4 = 1626$ Btu per lb fuel
10. Stack loss per lb moisture is $1000 + 520/2 = 1260$ Btu
11. Stack loss in moisture per lb fuel is $1260 \times 0.38 = 479$ Btu

To put any of these losses in percentage, merely divide by the 13,000 Btu in one pound of fuel.

THE RULES

1 Theoretical air required

Rule: Allow following lb per 1000 Btu

Anthracite coal	0.76
Bituminous and wood	0.74
Fuel oil	0.73
Natural gas	0.72

2 Water produced by combustion

Rule: Allow following lb per 1000 Btu

Anthracite coal	0.016
Bituminous and wood	0.025
Fuel oil	0.056
Natural gas	0.093

3 Total moisture in flue gas

Rule: Add moisture in 1 lb of coal to No. 2, above

4 Theoretical CO_2, no excess air

Anthracite coal	19.5
Bituminous and wood	18.5
Fuel oil	15.0
Natural gas (CH_4)	12.0

5 Ratio actual air to theoretical

Rule: Divide No. 4 by actual CO_2

6 Total weight air supplied

Rule: Multiply No. 1 by No. 5

7 Percentage excess air

Rule: 100 times (No. 5 – 1)

8 Dry gas per lb fuel

Rule: 1 + No. 6 – No. 3 – ash

9 Stack loss in dry gas

Rule: Subtract room temperature from stack temperature. Heat loss (Btu per lb fuel) is this temperature difference × 0.24 × No. 8

10 Stack loss per lb moisture

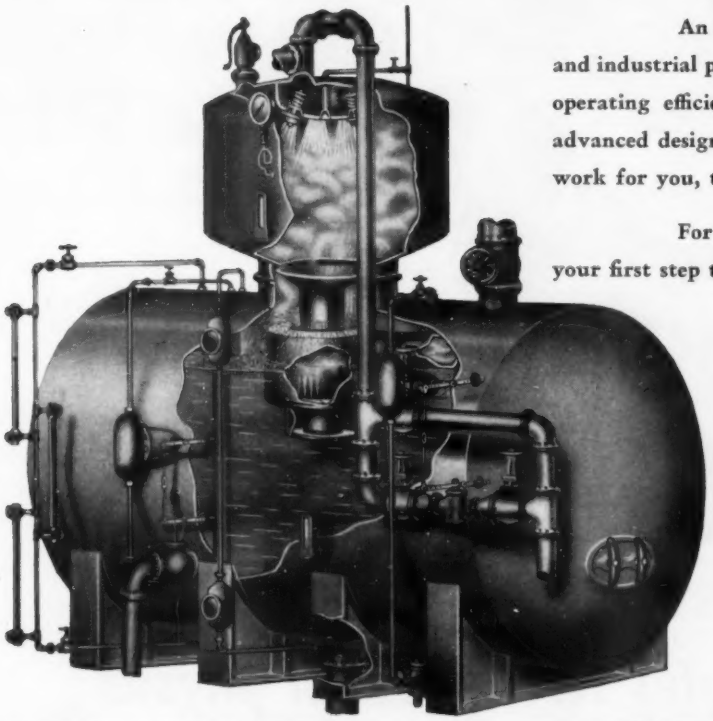
Rule: Btu = 1000 + ½ flue temp (F)

11 Moisture stack heat loss per lb of fuel

Rule: Multiply No. 3 by No. 10

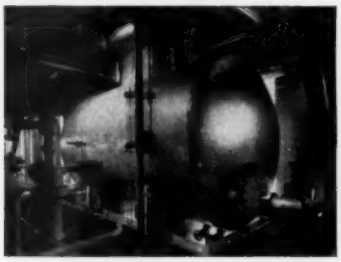
In Deaeration, too

BELCO Builds a Complete Line-



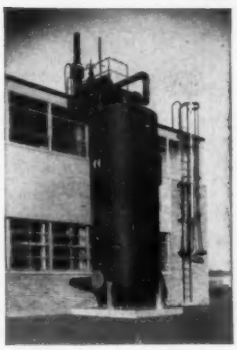
An increasing number of well known utility and industrial plants are using Belco equipment to increase operating efficiency and decrease operating costs. Belco advanced design and application experience can be put to work for you, too.

For technical assistance write or call Belco — your first step to lower costs.

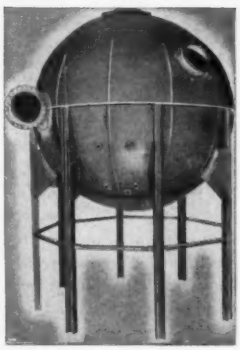


SPRAY TYPE — Belco Deaerator in large eastern oil refinery. Has a capacity of 300,000 lbs/hr.

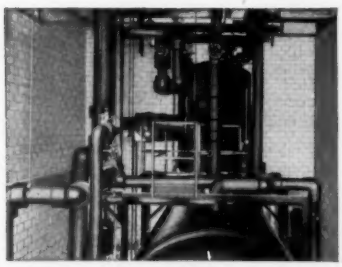
MARINE TYPE—Typical Belco marine heater furnished to shipyards. (Approved by Lloyds of London)



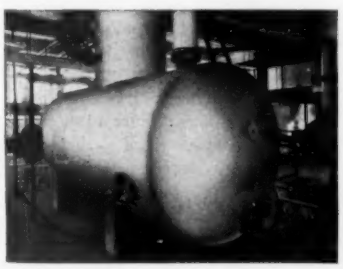
OPEN TYPE—Deaerator at large eastern pharmaceutical plant. Capacity of 80,000 lbs/hr.



VACUUM TYPE — Unit shipped set-up to midwestern utility. Has 150,000 lbs/hr capacity.



SPRAY TRAY TYPE — Belco Deaerator at New York State institution boiler house. Capacity 120,000 lbs/hr.



TRAY TYPE — Belco Deaerator at southern municipality. Has a capacity of 125,000 lbs/hr.

Belco

Boiler Feedwater Heaters • *Water Softeners* • *Filters* • *Clarators*
Demineralizers • *Automatic Process Control Panels*

BELCO INDUSTRIAL EQUIPMENT DIVISION, INC.
110 PENNSYLVANIA AVENUE, PATERSON 3, N. J.

REGIONAL OFFICES: *Philadelphia, Pa., Chicago, Ill., Houston, Texas*
North Hollywood, Cal., Montreal, Que., Toronto, Ont.

Representatives in all principal cities of the United States and Canada

BELCO DESIGNS, ENGINEERS & FABRICATES WATER PROCESSING EQUIPMENT

"Snifty took on bunkers all right, but this time it was in his own cabin."

Marmy formulates two 'laws' of physics

► "BILGEWATER on your atomic power plants," roared Marmaduke Surfaceblow during a heated technical discussion at that emporium of liquid refreshment and learning, the Bent Propeller Bar. "I'll steer you clear on how I formulated my Second Law of Fuel-Oil Filling Lines."

That amazing remark not only stopped the show, but even Marmy's oldest shipmates cocked a fishy eye in his direction to see if the old consulting engineer had finally snapped a gusset stay. There was no question about it, though, for Marmy's foghorn voice had clearly announced that he had "formulated a law."

With all eyes upon our hero, his befuddled audience waited for him to get this law business squared away. Marmy slowly turned his back to the bar, listed his old gray bowler to starboard, gave his admiring table and bar audience the onceover, then blasted away.

"Back in the fall of 1922 I was made port engineer for the Southern Shipping Lines in Mobile, Alabama," he roared. "Besides a few coal-burning freighters, we had five new Hog Island ships, which were the Liberty ships of World War I. All our ships were on the South American run, stopping in Havana or other West Indies ports on the way to the Panama Canal.

"Our new ships burned bunker-C oil in three cross-drum, watertube boilers. Main drive was a Curtis-type steam turbine with reduction gears. The old coal burners had Scotch boilers and up-and-down engines. But keeping my ships on schedule was easy compared to keeping peace between some of the older chief engineers.

"One character was Charley Eppinger, known along the waterfront as Snifty. He was tough looking, but as meek as a snail. He had a mangy head of hair with patches of scalp showing, like an old alley cat's beat-up hide. And it turned out that he was a sneaky guy who'd do anything for revenge. When I joined the line he was chief on the old coal burner *SS Savannah*, but I intended greasing the gangplank for him.

"The other character was Mike Brennen, known as Slicebar Brennen. Only thing I could find wrong with Slicebar was his bullheadedness. He'd antagonize everyone and never admit being wrong. But he also had the good reputation of getting more revolutions out of a ton of coal than any engineer on the high seas—besides myself.

"As a reward, Brennen had been given one of the new oil-burning ships. Running an oil-burning turbine-drive job was easy for him after years of shoveling coal and overhauling reciprocating engines. Slicebar had the new *SS Tuscaloosa*—and that's what made Snifty jealous. He couldn't see himself being left on his old coal burner while his rival was promoted to a new ship.

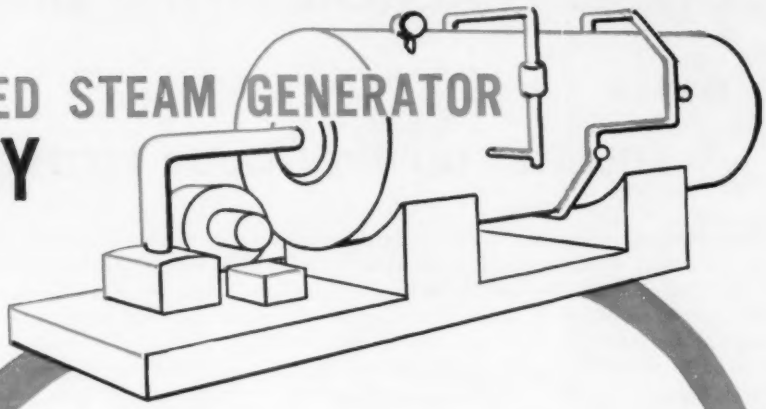
"One trip the two ships were in Mobile together, tied up alongside our home dock. Snifty's ship had just been bunkered with coal. An oil barge was due to fuel Slicebar's ship at 10 pm. Then the *Savannah* was to shove off for Philadelphia at midnight with the tide.

"But shortly after Slicebar started fueling, the port side of his deck amidships was covered with fuel oil. Aboard most ships, the 6-in. filling line comes up from the fireroom into a T-connection amidships. Here the line branches to both sides of the ship with cover plates on ends. In this way the ship can fuel from either side. What happened was that Snifty bribed a dock hand to back off the six ¾-in. bolts holding the port-side filling-line cover plates, so the oil spilled out.

(*Continued on page* 192)

Ideal Combination

FOR TOP SELF-CONTAINED STEAM GENERATOR EFFICIENCY



1

Nalco WATER TREATMENT

SCALE AND CORROSION PREVENTION

With a Nalco Service Policy and Nalco Chemicals to fit your water treatment requirements, you can keep your self-contained boilers operating indefinitely at top efficiency — without any of the costly difficulties caused by scale and corrosion. This part of the Nalco System was designed expressly to provide small boiler users with the same complete water treatment services enjoyed by thousands of the country's largest power plants. A new 4-page bulletin gives complete details on The Nalco System as applied to the modern self-contained boiler. Your copy will be sent promptly, without obligation.

Write for Bulletin 49

2

Nalco SR-155 FUEL OIL ADDITIVE

FUEL SAVING . . . CLEAN BURNERS

Nalco SR-155 is a *complete* fuel oil additive. It replaces two, three or more single-purpose additives to: (1) keep storage tanks, fuel lines and burners free of sludge and gum; (2) prevent soot formation in the firebox and flues; (3) inhibit corrosion throughout the fuel system; and (4) act as a combustion catalyst to assure complete burning of oil. Fuel savings and reduced maintenance costs usually more than repay the cost of continuous SR-155 treatment — and very little SR-155 is needed per 1,000 gallons of fuel oil! Details on Nalco SR-155 will be sent on request.

Write for Bulletin 46

NATIONAL ALUMINATE CORPORATION

6222 West 66th Place • Chicago 38, Illinois

Canadian inquiries should be addressed to Alchem Limited, Burlington, Ontario

THE Nalco® SYSTEM • Serving Industry through Practical Applied Science

JENKINS PRACTICAL PIPING LAYOUTS 74

How to plan a

SULFATE PULPING LIQUOR RECOVERY SYSTEM

An important economy of the sulfate pulping process is the recovery of the residual fluid (black liquor) collected from the digester and the subsequent washer operations in which it is used. The diagram shows piping for the recovery cycle, in which this fluid is converted to white liquor for re-use in the digester.

Black liquor from the washers, consisting of water, complex organic salts, and some sodium carbonate, is first concentrated in the multiple effect evaporators to facilitate later processing. Low pressure steam, admitted to the heat exchanger section of the last evaporator, boils the liquor. The resulting vapor passes through a catchall to separate the concentrate from the steam. The steam is returned to the heat exchanger section of the preceding evaporator where it boils the liquor. From the last evaporator, the concentrate flows to a direct heat (cyclone) evaporator. Here it is sprayed into the flue gas from the furnace, for additional concentration.

To decrease its viscosity, the concentrated liquor is sent to an indirect steam heater. It then proceeds to the salt cake mixing tank, where the proper amount of salt cake (sodium sulfate) is mixed into the solution to assure eventual restoration of the sulfidity required of white liquor. The concentrate is again passed through an indirect steam heater to reduce viscosity, and is then sent to the furnace, where it is burned. In the furnace, excess water is driven off and the chemical reduction of the organic salts takes place, the sodium sulfate becoming sodium sulfide. The resulting heat emission generates part of the steam required for plant operation and generation of electric power.

The smelt from the furnace is permitted to flow into the smelt tank, where it is thoroughly mixed with weak liquor and sent to the green liquor clarifier. Prior to the furnace treatment, the concentrate remains black liquor. After furnace treatment, it is called green liquor. At this point, the dregs are removed and sent to the dregs washer where they are sprayed with water and sent to waste. The resulting weak liquor is used in the smelt tank.

The clarifier green liquor, a solution of sodium sulfide and sodium carbonate, is sent to the lime slaker and classifier. Here it is mixed with calcium oxide. The lime grits are removed by the classifier and the solution proceeds to a series of causticizing agitators which thoroughly mix the green liquor and calcium oxide. Chemical reaction produces caustic soda (sodium hydroxide) and a precipitate of calcium carbonate (called mud) which goes on to the white liquor classifier. The solution of sodium hydroxide and sodium sulfide is known as white liquor.

In the classifier the mud is separated from the white liquor which is then sent on to storage for use in the digesters. As the mud settles and thickens, the resultant weak liquor is drawn off and sent to the smelt tank. The mud is washed and then conveyed to a lime kiln for chemical reduction to calcium oxide (lime), which is stored in bins for re-use in the lime slakers.

Jenkins Fig. 2651-A Gate and Fig. 2624 Check are recommended in this layout where valves are in contact with any liquor—white, black, or green—because they have the nickel iron bodies and stainless steel trim required to resist the corrosive nature of the liquors. Vapor flow between evaporators may be controlled with stainless steel valves, while steam and water flow can be controlled with I.B.B.M. or bronze valves. Higher pressure at heaters requires cast steel valves.

Consultation with accredited piping engineers and contractors is recommended when planning any major piping installation.

To save time, to simplify planning, to get all the advantages of Jenkins specialized valve engineering experience, select all the valves you need from the complete Jenkins line. It's your best assurance of *lowest cost in the long run.* Jenkins Bros., 100 Park Ave., New York 17. Sold through leading Industrial Distributors everywhere.

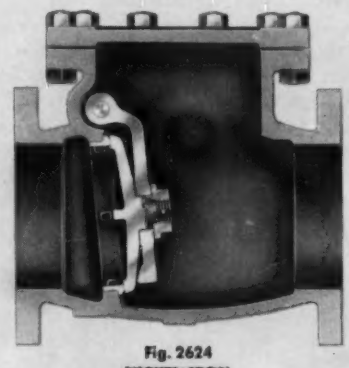


Fig. 2624
NICKEL IRON
Check Valve
with Type 316
STAINLESS STEEL
Trim
2" to 12"
200 lbs. O.W.G.
14" to 24"
150 lbs. O.W.G.

SULFATE PULPING LIQUOR RECOVERY SYSTEM

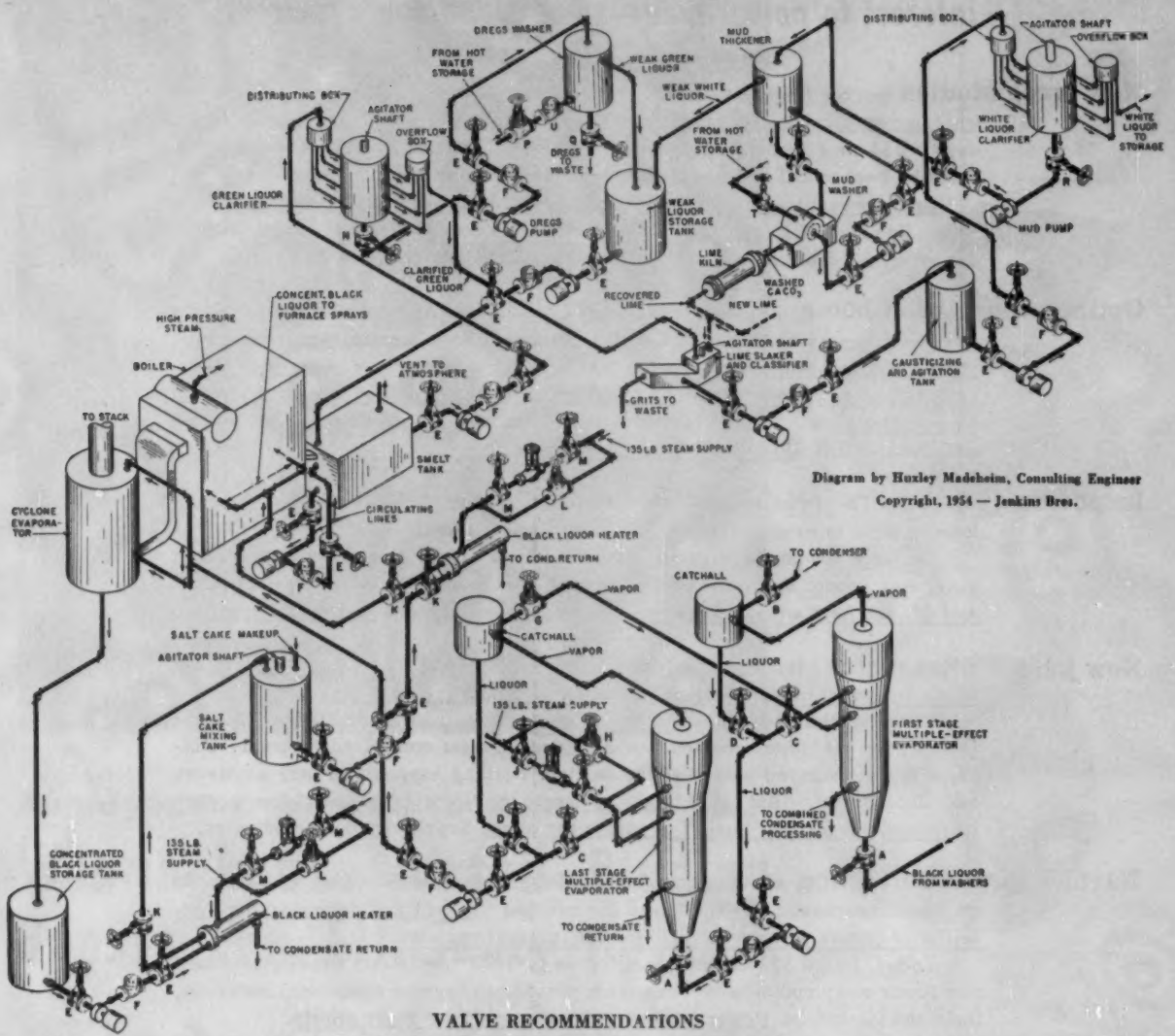


Diagram by Huxley Madeheim, Consulting Engineer

Copyright, 1954 — Jenkins Bros.

VALVE RECOMMENDATIONS

For details of Nickel Iron Valves, write for Bulletin 118.

CODE	QUAN.	JENKINS VALVE	SERVICE
A	2	Fig. 2651-A, Nickel Iron Gate	Shutoff multiple effect evaporator
B	1	Fig. 1317, Stainless Steel Globe	Control vapor flow to condenser
C	2	Fig. 2651-A, Nickel Iron Gate	Shutoff liquor from multiple effect evaporator
D	2	Fig. 2651-A, Nickel Iron Gate	Shutoff liquor from catchall
E	23	Fig. 2651-A, Nickel Iron Gate	Shutoff liquor pump
F	12	Fig. 2624, Nickel Iron Sw. Check	Prevent backflow through pump
G	1	Fig. 1317, Stainless Steel Globe	Control vapor flow
H	1	Fig. 1040, Cast Steel Globe	Steam bypass control
J	2	Fig. 1009, Cast Steel Gate	Control valve shutoff
K	3	Fig. 2651-A, Nickel Iron Gate	Liquor heater shutoff
L	2	Fig. 1040, Cast Steel Globe	Steam bypass control
M	4	Fig. 1009, Cast Steel Gate	Control valve shutoff
N	1	Fig. 2651-A, Nickel Iron Gate	Shutoff dregs from green liquor classifier
P	1	Fig. 613, I.B.B.M. Globe	Control water to dreg washer
Q	1	Fig. 2651-A, Nickel Iron Gate	Shutoff dregs to waste

CODE	QUAN.	JENKINS VALVE	SERVICE
R	1	Fig. 2651-A, Nickel Iron Gate	Shutoff mud from white liquor classifier
S	1	Fig. 2651-A, Nickel Iron Gate	Shutoff mud to mud filter
T	1	Fig. 106-A, Bronze Globe	Control water to mud filter
U	1	Fig. 2624, Nickel Iron Swing Check	Prevent backflow to water line

JENKINS
LOOK FOR THE JENKINS DIAMOND
VALVES
SINCE 1864
TRADE JENKINS MARK

Jenkins Bros

Speaking of power

personal slants on doings of interest to power men—some significant, some just odd

New smog studies put the finger on unusual chemical reactions that have time to take place when air over a big city stagnates. Then sunlight and ozone get in their licks, says a 134-page report from Stanford Research Institute. Further research sponsored by Western Oil and Gas Assn. aims at identifying reaction substances.

In the meantime, Los Angeles boosters will probably slide into hysteria – outwardly proud of sunny skies and highest known concentration of ozone; secretly nagged by the fear these may be root causes of smog discomforts.

Optimism begins at home in the Atomic Energy Commission. At least that's the reaction to recent remarks by Chairman Lewis L Strauss. These are the significant lines: "Some engineer-economists foresee that by 1960 – only 6 years from now – perhaps 10% of new power plants on the drawing boards will have specifications for nuclear reactors... by 1980 perhaps half of the new plants will use fissionable materials as fuel. However, I think these forecasts are too conservative."

Inducements to buyers of turbine-generators, announced by General Electric, are a forward-looking move to even out historic peaks and valleys in ordering.

On large orders, GE will go ahead on initial engineering and manufacturing; buyer may cancel up to six months, paying only minimum part of contract price. And GE will help arrange financing for charges normally made before shipment.

New job for ultrasonics is in burglar alarm by Walter Kidde & Co, so sensitive it can detect movement of warm air over a flame or rupture of a sprinkler.

Two grapefruit-sized units do it: one transmits "silent" sound waves at 19,200 cps; the other receives. An electronic master control continuously compares signal received with that transmitted. Nothing happens as long as waves are undisturbed. But slightest movement in protected space changes wave frequency, causes the "brain" to trigger the alarm. Sensitivity can be adjusted.

Naval Experiment Station at Annapolis had its beginnings just 50 years ago, with an original investment of $400,000 and the mission "to test and determine the suitability of certain steam machinery for use in naval vessels."

Today, in its $12-million plant, close to 1000 specialists develop and test new power and propulsion systems, work steadily to improve equipment, materials, fuels and lubricants. Power men everywhere benefit from these efforts.

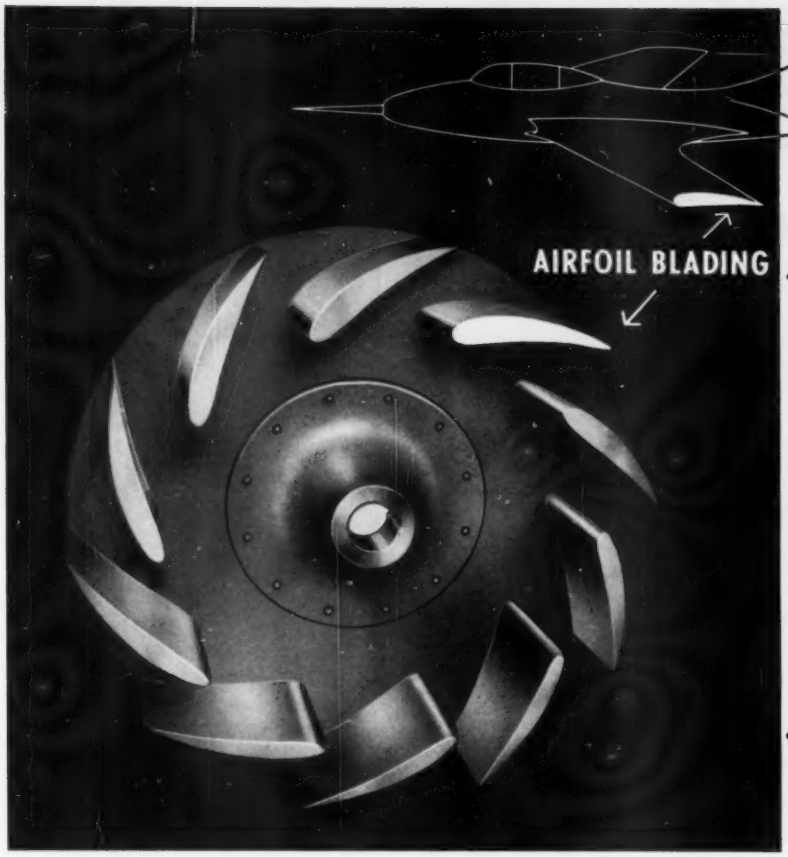
Slump in coal production has led to active planning for mergers to bring small operators into groups large enough to swing research and mechanization, get more efficient sales and distribution. And while production is down and stockpiles up, it seems likely that John L Lewis will think twice before making new demands.

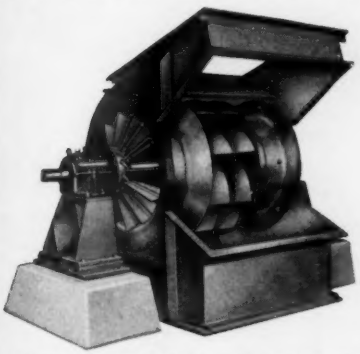
Typical of cost-cutting advances is a new extensible belt conveyor announced by Joy Mfg Co. By keeping coal flowing from face to main haulage system, it breaks transportation bottleneck, makes continuous mining machinery fully effective.

Two mobile gas-turbine plants in Brown Boveri's Baden, Switzerland shops are for Mexico's Comision Federal de Electricidad. Each 6200-kw plant consists of a car carrying turbine, generator and starting motor, and another with switchgear and transformer for voltage outputs of 13.8, 6.7, 4.16 and 2.4 kv.

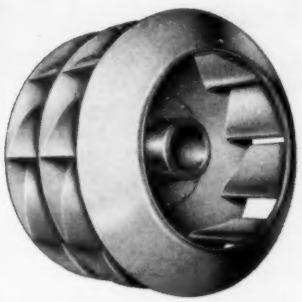
Because it needs no water, is quick to start, reliable and economical, the gas turbine promises to be a prime solution to the plant-on-wheels problem.

Lon Lawley





Heavy-duty Airfoil fan with section of housing removed to show wheel assembly. Air Volume is controlled by inlet vanes.



Each Airflow Blade is die-formed and reinforced to insure maximum rigidity.

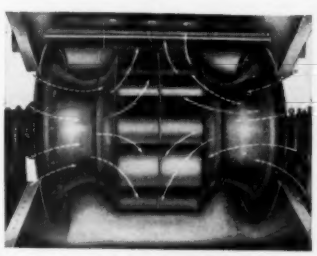
Aerodynamics applied to centrifugal fans:

Westinghouse Airfoil Blading Boosts Fan Efficiency to 92%

Quieter operation, too, for all heavy-duty applications

Westinghouse incorporates the airflow principle of an airfoil section into centrifugal fan wheel design to produce exceptionally high fan efficiencies! Performance proved, this Non-overloading Centrifugal Fan with Airfoil Blading reaches peak mechanical efficiencies of 92 percent . . . cuts noise level as much as 65 percent! Here's why: streamlined inlets that give smooth, full flow of air to the wheel . . . revolutionary Airfoil blades . . . improved housing that reduces turbulence. Benefit to you: a high-efficiency fan that pays for itself through yearly power savings.

This remarkable fan insures low operating cost and quiet operation in mechanical draft . . . high-velocity air conditioning systems . . . heavy-duty industrial applications . . . vehicular tunnel ventilation. For full information, contact your local Westinghouse-Sturtevant office, or write: Westinghouse Electric Corporation, Sturtevant Division, Hyde Park, Boston 36, Mass.



Airflow into, through, and out of fan is completely streamlined. Result: maximum air output per horsepower input.

WESTINGHOUSE AIR HANDLING

YOU CAN BE SURE . . . IF IT'S Westinghouse

J-80420

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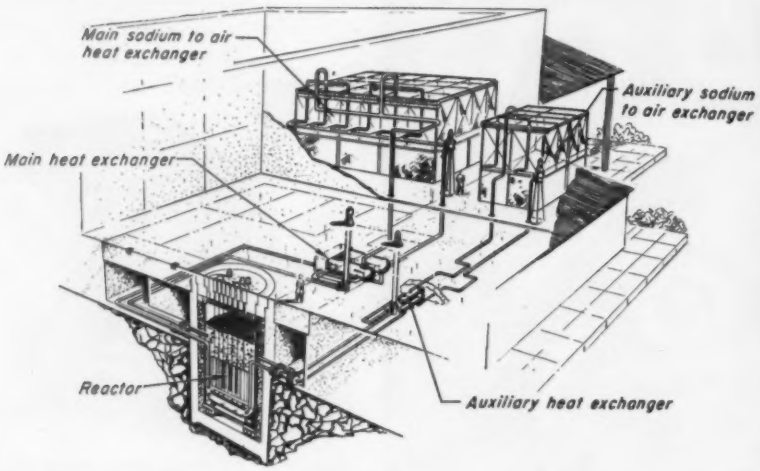
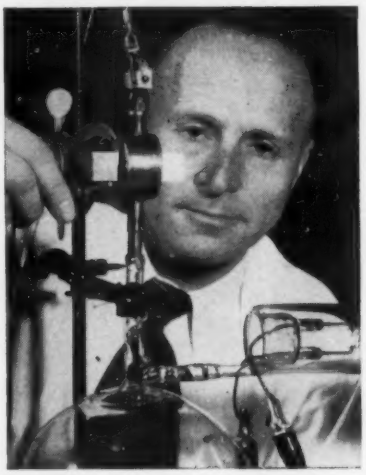
PLANT EQUIPMENT NEWS 156
NEW FREE BULLETINS 165



ARTIST'S CONCEPTION of sodium graphite reactor to be designed, built, operated by North American Aviation in a joint project with the Atomic Energy Commission



POWERFUL MAGNET is adjusted around vacuum system using new "ionic" pump

Reactor ordered from North American Aviation

► AS PART OF its program to develop competitive nuclear power, the Atomic Energy Commission has ordered a sodium graphite reactor to be designed, built and operated by North American Aviation, Inc. The project will cost ten million dollars, including research and development.

This reactor, called SRE (Sodium Reactor Experiment), will generate 20,000 kw in the form of heat and will operate at high over-all temperature.

Because the most essential development problems are in the reactor and heat exchanger system, no electricity will be produced at this time. The reactor will use uranium slightly enriched in U-235. It will be graphite moderated and cooled by 10,000 gals of sodium. The highly radioactive sodium coolant will give up its heat to a secondary sodium circuit. In a power plant this could be used to generate steam in a heat exchanger.

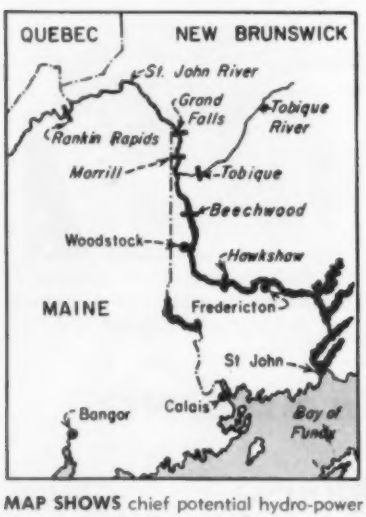
Simple experimental air pump produces extremely high vacuum

► A NEW TYPE vacuum pump can produce pressure as low as one billionth of normal atmospheric pressure. Developed by Drs A M Gurewitsch and W F Westendorp, General Electric Co, the "ionic" unit has no moving parts. Pumps now used for such high vacuum employ streams of oil or mercury vapor, not required in the new device.

Pump has a small stainless steel chamber between poles of an *Alnico* permanent magnet. Tungsten ring inside chamber is connected to positive side and wall of chamber to negative side of high-voltage circuit. Carbon plates are attached to inside wall of chamber.

After ordinary mechanical vacuum pump exhausts air to about one hundred-thousandth of an atmosphere, from device being evacuated, ionic pump is connected. With electric current on, gas discharge occurs. Electrons in discharge are attracted to the tungsten ring, but are prevented from being collected immediately by magnetic field, and caused to oscillate through the ring.

During oscillations they hit many gas atoms, which are ionized. Positively charged ions are pulled toward the negatively charged pump walls. On the way, ions strike the carbon plates and are driven into them and held there, reducing gas pressure.



MAP SHOWS chief potential hydro-power sites to be developed on St John River

St John River hydro projects have potential of 800,000 hp

► A REPORT OF the International St John River Engineering Board states about 800,000 hp can be developed on the St John River. This river rises in Little St John Lake, Maine and flows 425 miles to the Bay of Fundy. It drains an area of 21,600 sq miles.

Chief potential power sites are at Rankin Rapids (308,000 hp), Castle Hill (24,200 hp), and Fish River (10,000 hp), all in Maine, and at Morrill (88,000 hp), Beechwood (135,000 hp), Hawkshaw (151,000 hp), in New Brunswick. In addition to these potential sites 76,500 hp has been developed at Grand Falls, under 132-ft head, by Gatineau Power Co. New Brunswick Electric Power Commission has completed

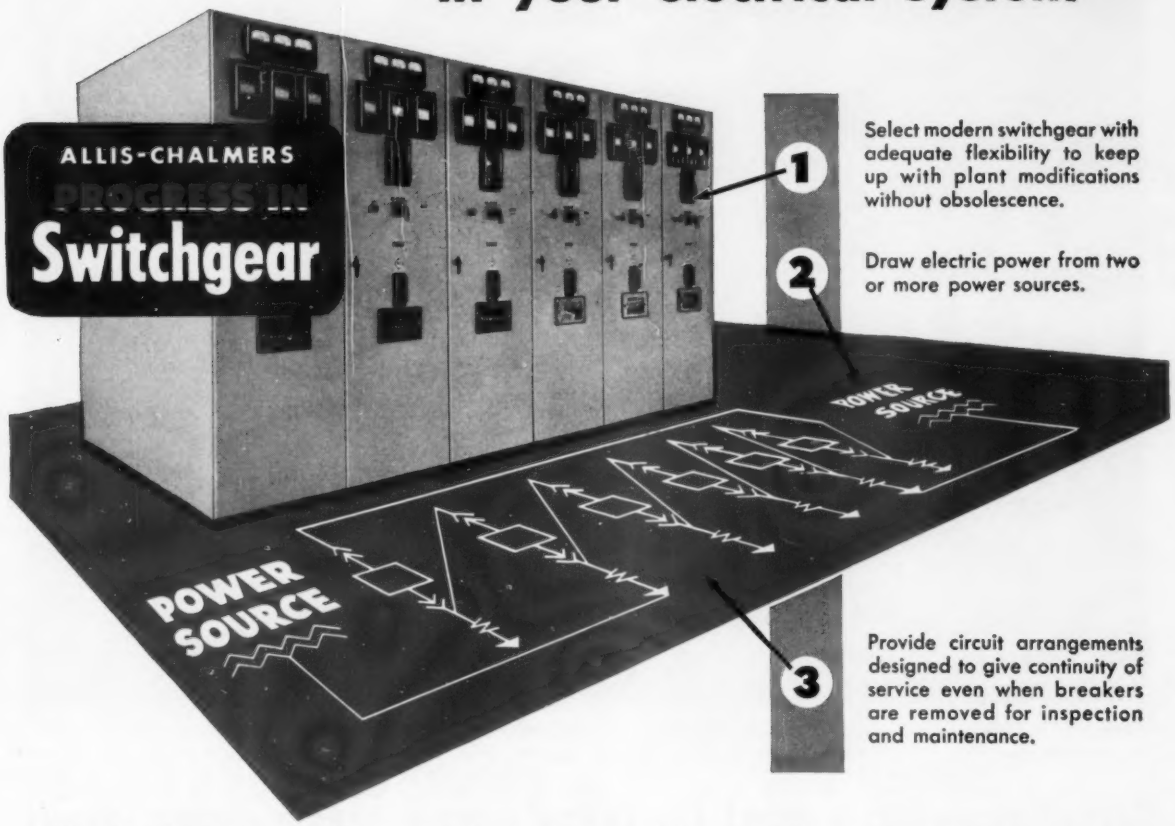
(*Continued on page* 222)

For coming events see page 224

For uninterrupted power . . .

combine these 3 features

in your electrical system



Select modern switchgear with adequate flexibility to keep up with plant modifications without obsolescence.

Draw electric power from two or more power sources.

Provide circuit arrangements designed to give continuity of service even when breakers are removed for inspection and maintenance.

The 3 points above offer a simple rule of thumb for planning an electrical system that will provide uninterrupted power.

Key to the operation of such an electrical distribution setup is the switchgear. Allis-Chalmers has specialized in this type of switchgear engineering and offers these advantages to the user:

SAVES SPACE — Allis-Chalmers switchgear compartments are designed with room to permit adding special transfer bus or ring bus arrangements without adding auxiliary cubicles.

SAVES COST — No matter whether you eliminate duplicate facilities or simply eliminate extra cubicles, there is a substantial cost saving with Allis-Chalmers switchgear.

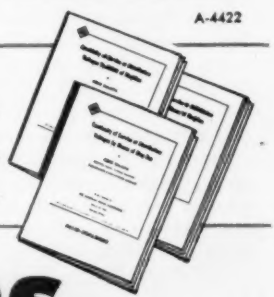
SAVES TIME — Allis-Chalmers dry-type bus joint insulation makes it easy to add or remove switchgear cubicles. No insulating compounds to melt . . . no fuss . . . no muss.

GET COMPLETE INFORMATION on Allis-Chalmers switchgear designed to meet needs for continuous power. Call your nearby Allis-Chalmers office, or write Allis-Chalmers, Milwaukee 1, Wisconsin.

A-4422

Ask for these booklets:

- ☐ Primary Switchgear Arrangement for Chemical Plants.
- ☐ Continuity of Service at Distribution Voltages by Means of Ring Bus.
- ☐ Design Considerations of Switchgear for Pipeline Substations.



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TECHNICAL BRIEFS

Latest engineering developments for busy power men

18 Digests for you on:
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STEAM POWER
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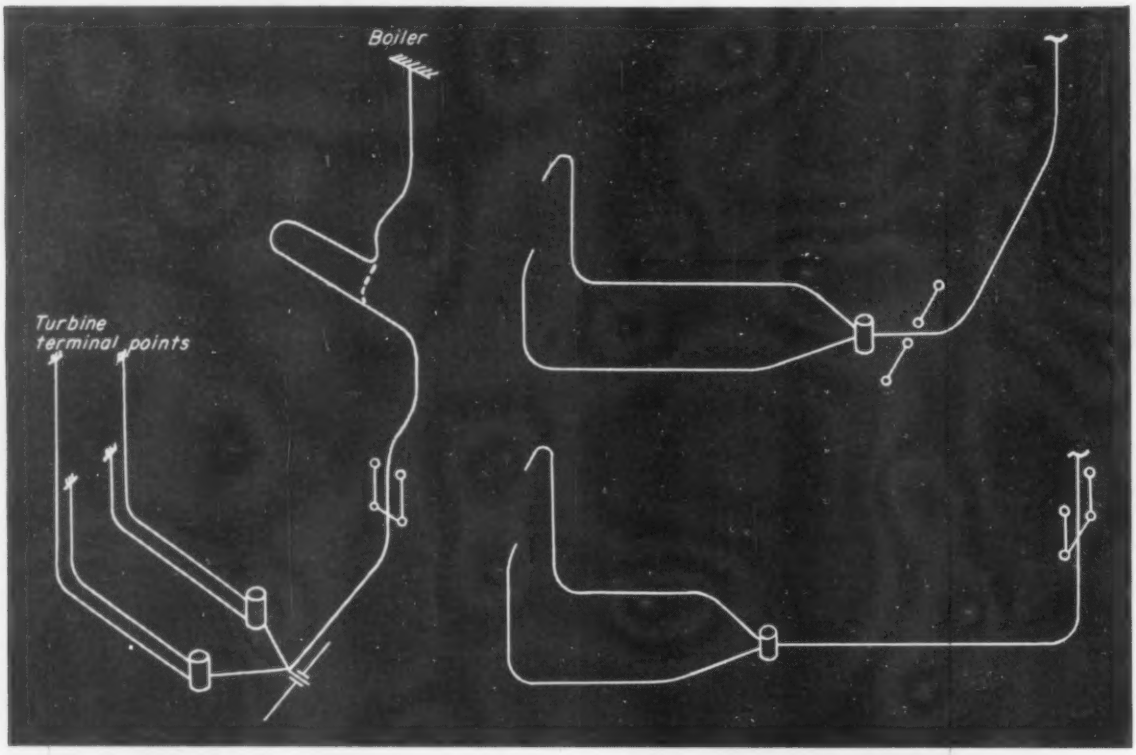


MAIN STEAM LINE with two restraints requires solution of 26 simultaneous equations for flexibility check by full analysis

HORIZONTAL tie-rods, *top*, can protect small pipes on end of system. Solid-rod hanger, *bottom*, is also popular at present

Better analysis: a must for today's main steam piping layout

Design of steam-piping systems for large central-station applications. *By R L Jackson and L H Johnson, General Electric Co.*

One of the main jobs facing central-station designers is steam-piping layout. Importance of this job has increased many fold in the last few years and indications are that it will continue.

In the past, steam conditions were low compared with those in general use today and piping was comparatively thin-walled. Ample flexibility was provided, the systems being simple enough to analyze, without many complications. Carbon or low alloy steels used had enough ductility to relieve any high stresses present. Usually only one pipe connected the boiler and turbine and expansion forces and moments applied at end points were not limiting factors.

Today, with temperatures of 1000 F and higher, and pressures well over 2000 psi in units with large ratings, steam pipes become heavy-walled, expensive items.

General use of the reheat cycle means a large increase in the number of pipes connecting boiler and turbine. Combined effect of expansion forces and moments of all the pipes on the end points becomes a limiting factor. This is true of turbines, where alignment must be maintained within close limits.

These factors, along with the need to keep costs at a minimum and reliability at a maximum, make it essential to perform a thoroughly accurate analysis of piping-system flexibility. *ASME paper No. 54-SA-69.*

Analysis of pipe systems with special expansion features. *By J E Donahue, Westinghouse Electric Corp.*

Paper discusses devices for absorbing movements in a piping system. More specifically, the devices resemble either circular flat-plate bellows-type expansion joint or a toroid-type expansion joint with or without tie rods to carry the hydrostatic end thrusts. The system is a pipe with thermal movements to be absorbed.

A method for calculating stresses in the parts resulting from axial displacement, rotation and pressure is presented. In addition, paper gives a method for determining in-plane and out-of-plane spring constants for the devices. Thus, the devices can be converted into an equivalent length of straight pipe.

Total net end reactions and stresses in the system are evaluated by incorporating the equivalent length into any standard mathematical flexibility analysis for a piping system. *ASME paper No. 54-SA-70.*

Directions for ordering papers on page 212

Looking for the right packing for your centrifugal pumps?

For shaft speeds to 1750 RPM Johns-Manville Centripac seals better

WEAR on centrifugal pump shafts as well as on oscillating and rotating rods of other equipment is minimized by J-M Centripac. This is because the square cross section of this packing provides the maximum contact surfaces. Thus, it insures a tight seal with the least friction and gland pressure.

Because Centripac is plaited square it retains its shape indefinitely, thus maintaining maximum surface contact for long periods of time. It is made from long-fiber asbestos yarn, thoroughly lubricated and graphited. It seals against fresh or salt, hot or cold water, oil, ammonia, brine, gasoline, and certain weak acids and other chemicals. Because of its wide application, it is a favorite of plant men everywhere.

For general service, Style #7 Centripac is recommended. It contains no wire, is soft enough to conform readily to the packing space, and stands up well in service. It comes in coil form, Style #C-7 and Ring form, Style #R-7. Sizes 3/16" and up.

For higher shaft speeds, J-M Plastic Packings reduce friction and scoring of shafts and sleeves

Higher centrifugal pump speeds make friction increasingly important in packing and shaft life. That is why J-M Plastic Packings have been designed to have the homogeneous structure and low friction so essential to long packing life in this service.

The exact composition of these packings varies according to the service conditions for which each particular style is designed. As an example, one of these, Style No. 610 is an excellent general maintenance packing for service against steam, air, ammonia, gases, etc. up to 550F. It is made of selected asbestos fiber mixed with pure graphite and a small amount of non-friction metal, then bonded with a heat-resisting compound to form a pliable coil or spiral. It is furnished in sizes of 1/8" and up.

YOUR J-M PACKING DISTRIBUTOR will gladly recommend the right packing for your equipment, and furnish it from stock for your immediate requirements. Write Johns-Manville, Box 60, New York 16, N. Y. for his name and address. In Canada, 199 Bay St., Toronto 1, Ontario.

JOHNS-MANVILLE JM PRODUCTS

Johns-Manville PACKINGS and GASKETS

More TECHNICAL BRIEFS

Begins on page 152

Nuclear power

Nuclear fuels for power generation. *By W F Friend, Ebasco Services, Inc.*

Production of electrical power from nuclear fuel in the systems now being developed is by the indirect method involving use of heat to generate steam for driving conventional turbine-generator units. Alternatively, gases like helium or carbon dioxide might be heated for use with gas turbines. Such thermal cycles, with various modifications, represent the only basic method now known for practical application to power generation.

Direct methods, whereby controllable electric power could be extracted from constituents within the atom, have been proposed on a theoretical basis, but are outside the realm of practicablity today.

Energy can be secured from nuclear reactions either through fission of heavy atoms to produce lighter elements, as in the A bomb, or by the fusion of light nuclei to create heavier atoms through a thermonuclear process as in the sun and H bomb.

Uranium and thorium are the sole materials for the first type, and hydrogen in its several forms is the basis for the second. The fusion process requires enormous temperatures and other conditions so difficult to produce and to control that no justification has yet been found for research on power generation by such method. Consequently, practical nuclear fuels comprise only uranium and thorium, together with plutonium derived from uranium. The paper contains a large number of costs involved in nuclear power generation. *APC paper.*

Working-stress criteria for nuclear power plants. *By B F Langer, Westinghouse Electric Corp.*

There are two respects in which strength calculations for nuclear power-plant components may differ from calculations made for conventional heat-power or process equipment. One is greater importance of thermal stresses due to generation of heat inside the material of the structure. Other is the frequent use of unfamiliar materials.

Paper proposes a method for combining stresses produced by fluid pressure with those produced by thermal gradients in order to arrive at a practical estimate of the safety factor in a structure like a pressure vessel. Because of relaxation of thermal stress, it is possible to show certain operations are safe even though a simple addition of pressure stress and thermal stress gives too high a value.

Relative importance in reactor design of such physical properties as ductility, creep, endurance limit, creep-rupture strength, impact strength and notch sensitivity are discussed. *ASME paper No. 54-SA-59*

Mechanical design of liquid metal-cooled nuclear reactors. *By C R Stahl, Knolls Atomic Power Laboratory, General Electric Co.*

Because of unusual emphasis on certain facets of the design of liquid metal-cooled nuclear reactors and lack of experience in this field, it has been necessary to approach all design problems with a fundamental analytical and experimental viewpoint.

Analysis shows there can be many orders of magnitude difference in severity of certain reactor thermal-stress problems when compared to normal experience. Radioactivity is another problem, and is related to the difficulty of obtaining complete reactor-system tests.

Because of these and other difficulties, reactor designers must take the attitude that the system must be completely dependable before installation. Design must be thoroughly analyzed and tested before radioactive operation. Many problems met in modern design are analyzed and reduced to practicable dimensions for the designer to follow. *ASME paper No. 54-SA-60.*

Directions for ordering papers on page 212

NUCLEAR ENGINEERING CLASSIC

Many readers are following POWER's *study course in Nuclear Engineering, prepared by Messrs Schwenk and Shannon. Installment No. 3 appears on page 93 of this issue.*

We wish to call the attention of students of this course, and others interested in nuclear energy, to an extraordinarily fine article that occupies eight pages in the September issue of "Westinghouse Engineer". In this Dr W E Shoupp, assistant manager, Atomic Power div, Westinghouse Electric Corp, Pittsburgh, Pa, explains the scientific fundamentals in a clear, thorough and attractive manner.

We understand a very limited number of copies of the issue are being held for engineers who may be particularly interested.

Steam power

Air-preheater size selection to improve over-all steam power-plant efficiency. *By B C Mallory and W F Allen, Jr, Stone & Webster Engineering Corp.*

Steam power-plant over-all thermal efficiency may be improved by selection of the optimum size of air preheater to operate in series with a steam air heater. Use of a steam air heater is particularly advantageous with oil or high-sulfur coal fuel. Studies of two plants show that with oil high efficiency and economy are achieved when inlet air is heated 60 to 70 F above average ambient at full load.

The air bypass is strictly a protective measure as it does not change the permissible exit-gas temperature for a given ambient temperature. With air bypass, the largest preheater from which any significant incremental gain in efficiency will be obtained is the size that can be operated at maximum load and average ambient temperature without bypassing.

Hot-air recirculation and steam air heating permit a lower exit-gas temperature than allowable with ambient air and are, therefore, more than protective measures since dry-gas loss may be reduced to a lower value than with ambient air. Besides, with steam air heating using extraction steam, every pound of steam extracted represents increased by-product power generation and results in an improvement in turbine-cycle efficiency.

For extracting-condensing units, steam air heating appears to afford a greater opportunity than hot-air recirculation for increasing the over-all power plant efficiency.

For large air preheaters and low ambient temperatures, hot-air recirculation entails a prohibitive expenditure for fans and ducts because large flows are required. However, there have been cases in warm climates where hot-air recirculation has proved to be the most economical method. *ASME paper No. 54-SA-62.*

Comparative performance of turbine-generator units in saturated-steam cycles. *By N A Beldecos and A K Smith, Westinghouse Electric Corp.*

Paper extends performance data for central-station turbine-generator units into the region of saturated steam where few or no data are available for units having large ratings. A performance level and trend is established which is representative of what can be antici-

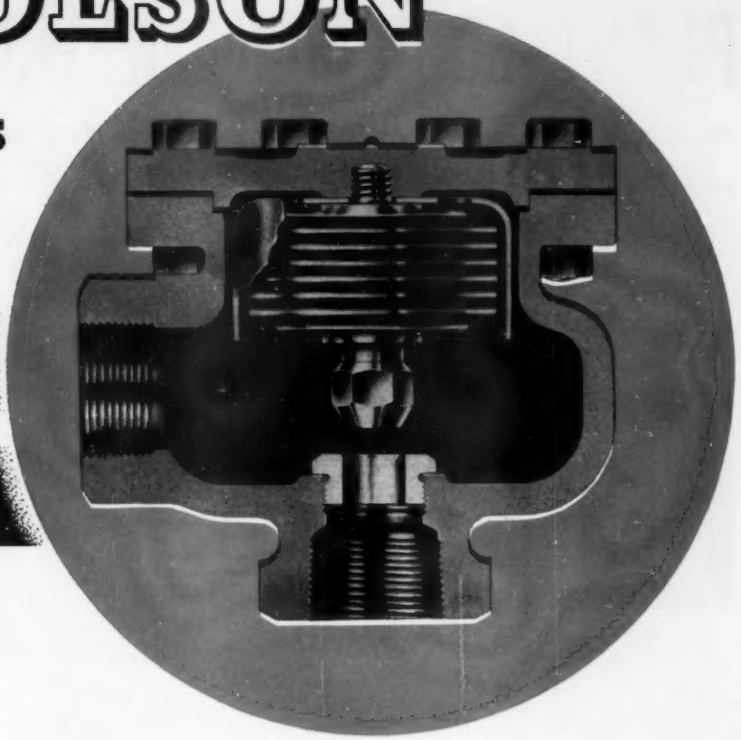
(*Continued on page* 202)

NICHOLSON

Steam Traps feature

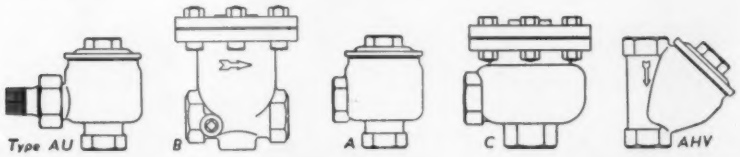
LESS parts

MORE capacity



Note the extreme simplicity of Nicholson industrial steam traps. The heavy-duty bellows integral with valve is the only moving part -- a substantial factor in their low maintenance cost. See also the larger valve orifice. This noteworthy feature results in Nicholson's 2 to 6 times average drainage capacity.

A recent survey showed the features following also to be reasons why plants with standardization-for-economy programs are increasingly adopting Nicholson traps: (1) Operate at lower temperature differential; fast action keeps equipment full of live steam; higher temperatures. (2) No air-binding; eliminate costly fluctuation of operating temperatures. (3) Freeze-proof; freely installed outdoors. (4) No need to change valves for varying operating pressures. (5) Record for low steam waste; as little as 1%.



FIVE TYPES FOR EVERY PROCESS, HEAT, POWER USE

Bronze, semi-steel or cast steel construction. All 5 types have stainless steel valves and seats; bronze, monel or stainless steel bellows. Sizes, ¼" to 2"; pressures from vacuum to 250 lbs.

SEND FOR TRAP CATALOG 953

This 32-page standard reference is complete with installation diagrams as well as charts and formulae for determining proper size of trap.

W. H. NICHOLSON & CO.

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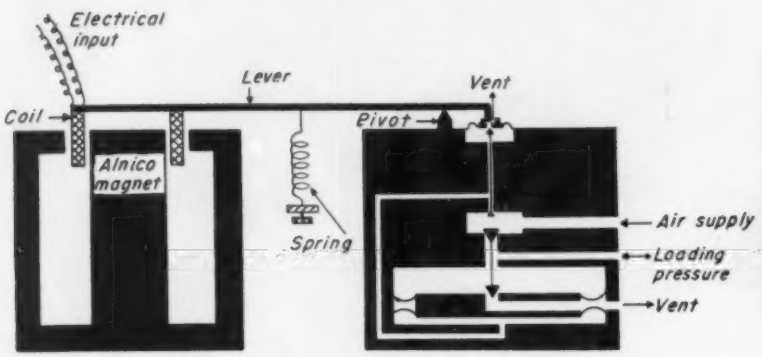


Power relay unit eliminates transmission lags normally encountered in all-pneumatic systems

902 • A power relay, *Autronic type P2R*, is designed to utilize low cost and flexibility of air-operated valves, without transmission lags common to pneumatic systems.

The unit, an electro-pneumatic transducer, operates with manufacturer's *Autronic* control system. Transmission lags are eliminated as unit takes electrical output from *Autronic* controller or manual control and converts it to air-loading pressure proportional to electric current. No electric motors, boosters or slide wires are employed. Equipment can be made explosion proof.

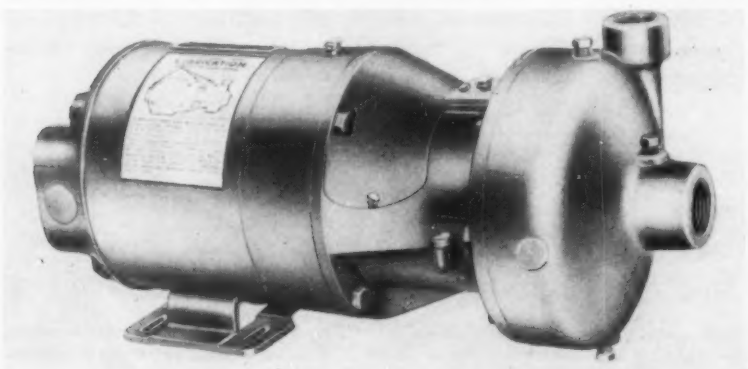
Unit operates on null-balance principle in which a magnetic force is balanced against force produced by air-output pressure from the pneumatic pilot. Electrical side of relay consists of a moving coil in a permanent-magnet field. It is adjusted so 4-milliampere current gives air-loading pressure of 3 psi, and 8 milliampere current produces 15 psi output with a direct-acting power relay. Other higher air-pressure ranges are available. Unit can be used either as reverse-acting or direct-acting.

Manufacturer claims that since the power relay contains no vacuum tubes, maintenance is minimized and consists mainly of occasional cleaning of pneumatic pilot and booster relay.

A bracket is provided for wall mounting, or it may be mounted directly on valve by a pipe connection to the valve diaphragm chamber. Full details on request.

The Swartwout Co, 18511 Euclid Ave, Cleveland 12, Ohio

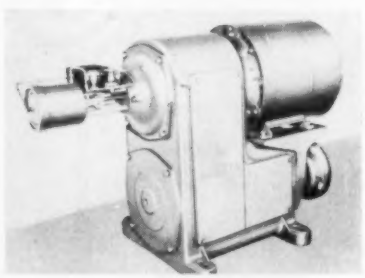
For more data on these items, use post cards p 165. Identify your request with item number.



Water pressure booster eases strain on local utilities

905 • Low cost pressure booster is a centrifugal pump of corrosion-resistant bronze construction, available in many sizes. It is designed primarily to aid local utilities to keep pace with rapid rate of building construction. Small, compact unit utilizes specially designed and constructed sleeve bearing motor for extra quiet operation. Pump can be installed directly in lead-in pipe from water main and is operated automatically by a switch that detects changes in water pressure. When city water pressure drops below a minimum setting, switch starts pump to increase water pressure.

Bell & Gossett Co, Morton Grove, Illinois



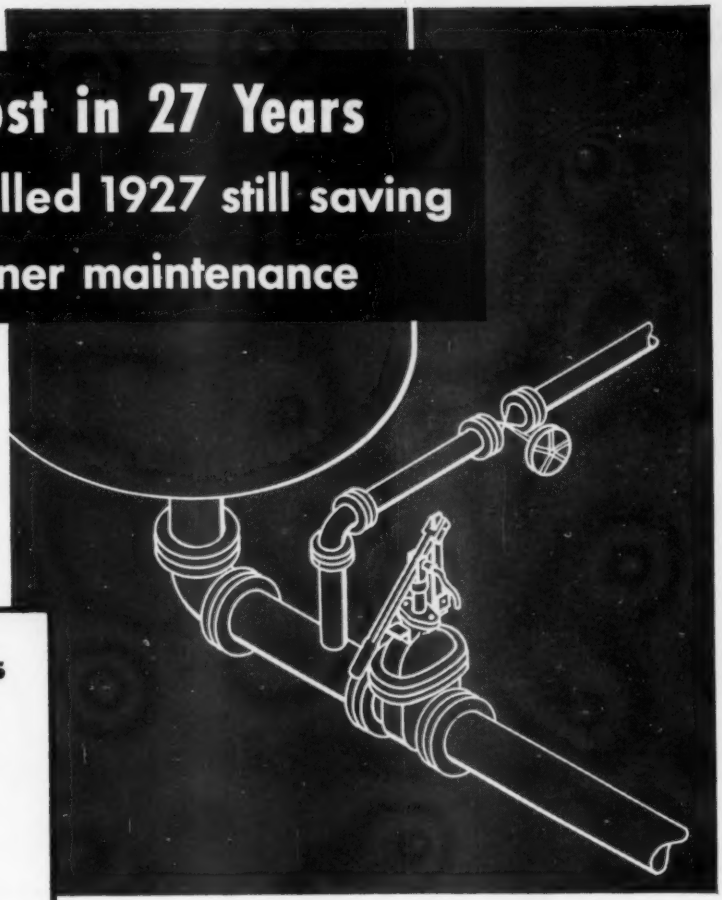
Auto-pneumatic control

914 • Auto-pneumatic control with "linear" output speeds is available for Reeves *Vari-speed Motodrive* in all sizes of fractional and integral hp capacities. The control is a valve positioner and pneumatic piston connected to the speed shifting mechanism. Change in position of piston automatically changes output speed. Piston position is determined by a valve positioner operated from the 3 to 15 psi signal sent from any instrument control. Request bulletin M-542 for full information.

Reeves Pulley Co, Columbus, Ind.

No Repair Cost in 27 Years

Quality Valve installed 1927 still saving on water softener maintenance



The Installation

At Phoenix Manufacturing Company, Joliet, Illinois, steel and rubber products plant. Original installation of 6-inch Crane quick-opening iron gate valve on flush-out line from water treating tank in soda ash-lime softener system.

Valve Service Ratings

SUITABILITY: Never failed

FEATURES: Rugged, easy-to-service design

MAINTENANCE COST: Zero

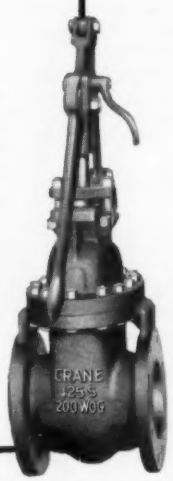
SERVICE LIFE: 27 years—still on job

OPERATING RESULTS: Lower cost water treating

AVAILABILITY: Crane catalog item—Current No. 471

The Valve

Further improved inside and out in many ways since 1927, modern Crane Iron Body Gate Valves keep making these performance records. Quick-opening design No. 471 shown, is but one member of this big, complete in size and pattern family. Includes OS&Y and inside screw valves; all iron and brass trim; screwed, flanged, and hub ends. Whatever your need, Crane lists it in your No. 53 catalog—or ask your Crane Representative.



The Case History

With each operation—2 or 3 times daily—more than 27 years—this Crane valve has demonstrated the thrift of a quality-buying policy.

Not once has it failed to open wide quickly, smoothly, and again to seat tightly in this customarily rough-on-valves service.

Not once has this valve undergone any repairs or maintenance. The only attention was periodic routine servicing with occasional clean-up. Still the customer reports: "good and satisfactory service."

Today, more than ever, quality buying is your best guard against high maintenance cost. And today, as always, better quality in valves means Crane valves.

THE BETTER QUALITY . . . BIGGER VALUE LINE . . . IN BRASS, STEEL, IRON

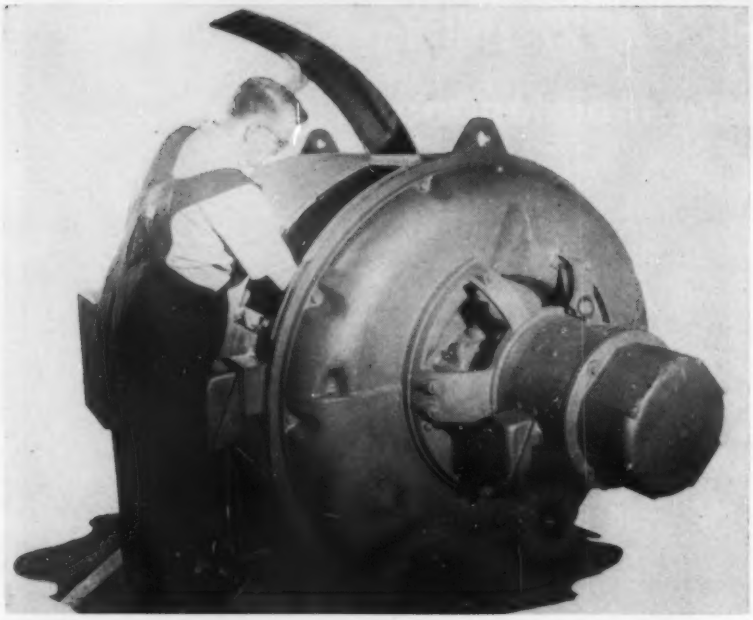
CRANE VALVES

CRANE CO., *General Offices:* 836 S. Michigan Ave., Chicago 5, Illinois
Branches and Wholesalers Serving All Industrial Areas

VALVES • FITTINGS • PIPE • PLUMBING • HEATING

More EQUIPMENT NEWS

Begins on page 156



Easy accessibility is feature of redesigned slip-ring motors

900 • Redesigned line of large end-shield bearing synchronous and wound rotor induction motors, of four and more poles, feature greater mechanical protection and increased accessibility to mechanical and electrical parts, according to manufacturer. Motors' fabricated steel stator yoke has been lengthened to accommodate slip rings and brush rigging with access openings of ample proportions for brush inspection and maintenance.

Redesigned motors, *types AB* and *ANY*, utilize same capsule bearing and cast end-shield construction featured in company's standard large squirrel-cage induction motor line.

Rotor or slip-ring leads are not exposed in new design. Internal connections are made to an external rotor lead terminal box for conduit connection.

Overhung exciter mounting on synchronous machines is accomplished by means of a split bracket secured to motor end shield. Bracket permits full accessibility to capsule bearing. Upper halves of both bracket and end shield can be removed for access to motor windings without disturbing exciter or capsule bearing housing.

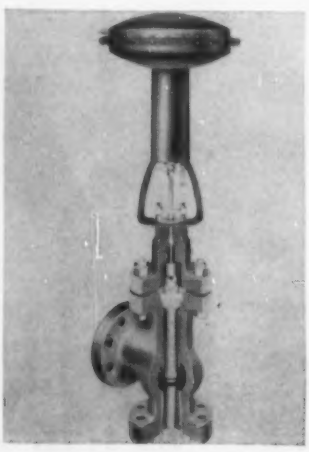
Allis-Chalmers Manufacturing Co, Milwaukee 1, Wis.

Valve type arrester

924 • *Thorex RM* (rotating machinery) lightning arrester is intended for use on motors, generators, synchronous condensers, ac side of rotary converters, dry type transformers and older pieces of oil-insulated apparatus. Available in 14 different line-to-ground voltage ratings from 3 to 27 kv. May be used in conjunction with parallel-connected wave-sloping capacitors to gain maximum protective characteristics.

Ohio Brass Co, Mansfield, Ohio

For more data on these items, use post cards p 165. Identify your request with item number.



Seal balanced angle valves

944 • These valves provide balanced control at high pressure differentials with tight shutoff. Force caused by line pressure working against cross-sectional area of plug is cancelled out by a drilled hole along axis of plug, intersecting radially drilled holes near the top. Line pressure transmitted through this passage exerts downward force on plug equal to upward force. Hence, valve can be positioned accurately at pressure differentials as high as 3600 psi with standard superstructures actuated by standard instrument air.

Pressure in the body bowl is sealed from the balancing chamber, providing tight shutoff. Sizes range from 1 to 8 in., with body ratings from 150 to 1500 psi ASA standard at 450 F. Bulletin 104-B.

Hammel-Dahl Co, 175 Post Road, Providence 5, R. I.

Heavy sight feed valve

941 • These valves are primarily designed for pressure or gravity oiling systems on paper mills, steam and gas engines, and gear units. Units have needle valve control, regulate oil flow from full flow to complete shutoff. All parts machined from bar stock. Sizes ¼ to ½-in. pipe thread, angle or cross pattern with brass bodies.

Oil-Rite Corp, 2317 Waldo Blvd, Manitowoc, Wis.

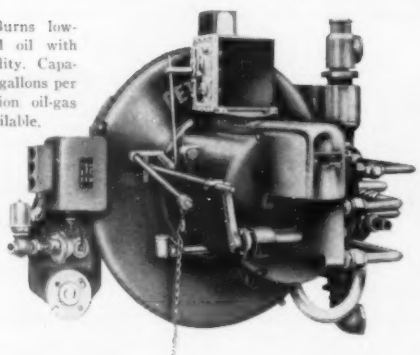
Is inefficient firing stealing dollars from your pocket?

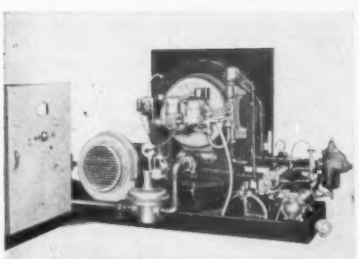
install a

PETRO INDUSTRIAL OIL BURNER

and save 3 ways

Rotary type. Burns low-cost heavy fuel oil with complete reliability. Capacities up to 200 gallons per hour. Combination oil-gas models also available.





Petro "Packaged Unit" (for oil or gas or both). A complete combustion system in which all elements are correctly balanced and integrated. Simply bolt to boiler front and make service connections and it's ready to go.

Send for free catalog today . . .

see our catalog in SWEET'S ARCHITECTURAL FILE or write for copy

1. Fire low-cost oils

Petro fires the heavy fuel oils (Nos. 5 and 6) which average 8% richer in heat value than the light burner oils, and cost less per gallon.

2. Save fuel and labor

They efficiently fire heavy oils with complete dependability, following load changes automatically. This makes fuel go farther and saves labor.

3. Low maintenance cost

They are sturdily built and thoroughly reliable. This means low maintenance costs.

There's a Petro burner to fit almost every boiler, in sizes from 11 to 200 gallons per hour.

Heating contractors everywhere recommend and install Petro oil equipment. For illustrated catalog write Petro, 3021 West 106th Street, Cleveland 11, Ohio.

In Canada, write 2231 Bloor Street West, Toronto, Ontario.

Residential Oil and Gas Burners, Oil and Gas Furnaces and Boilers
Industrial and Commercial Oil, Gas and Oil-Gas Combination Burners

PETRO

T.M. REG. U.S. PAT. OFF.

OVER 50 YEARS OF LEADERSHIP IN AUTOMATIC HEATING AND POWER EQUIPMENT

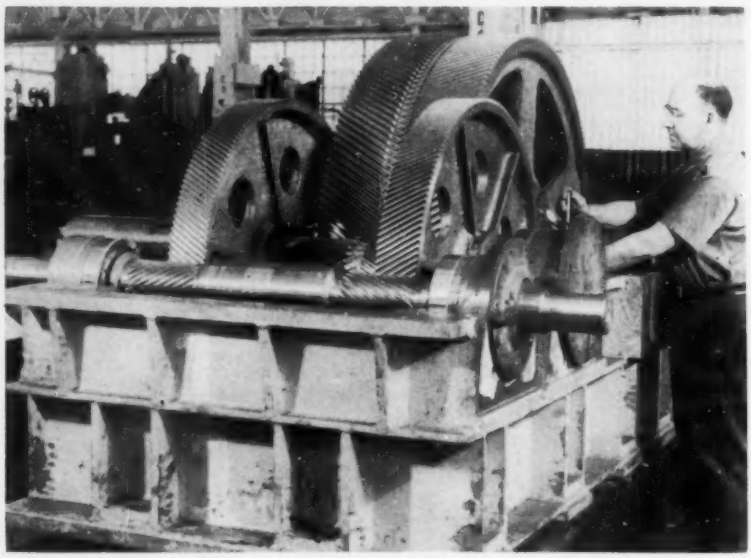
More EQUIPMENT NEWS

Begins on page 156

Shaft-mounted speed reducers

945 • These right-angle reducers use double-enveloping worm gearing. Reducer is mounted directly on the driven shaft, requires only a simple bracket or torque arm to prevent it from rotating around the driven shaft. Available in 2, 2½ and 3-in. center distances, with pinion under, pinion over or vertical shaft models. Reduction ratios range from 5 to 60:1. Loads that can be handled by the three sizes range from fractional to 3, 5½ and 9 hp, respectively.

Cone-Drive Gears, Div of Michigan Tool Co, 7171 E McNichols Rd, Detroit 12, Mich



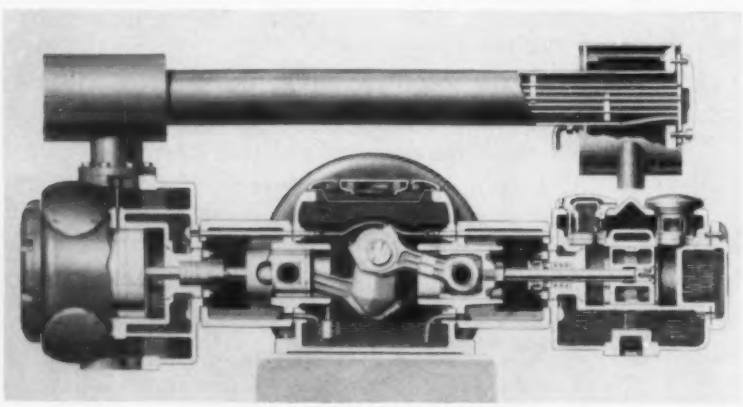
Industrial speed reducers for heavy industry application

904 • Speed reducer provides economical transmission of power at reduced speed from prime mover to driven machine. Line consists of a series of single-*type WSH*, and double-*type WDH*, reduction units. Thirteen standard ratios from 2.24 to 9.21 are available for *WSH*; sixteen ratios from 11.3 to 70 are available for *WDH*.

Units are external geared type with shafts arranged in a horizontal plane, resulting in high efficiencies. Design incorporates compact, rigidly constructed gear cases, precision gears and pinions, rolling-contact bearings and liberal-sized shafts. Photo shows *WDH* with top half of gear case removed. Full details from manufacturer.

Westinghouse Electric Corp, Box 2099, Pittsburgh 30, Pa.

For more data on these items, use post cards p 165. Identify your request with item number.



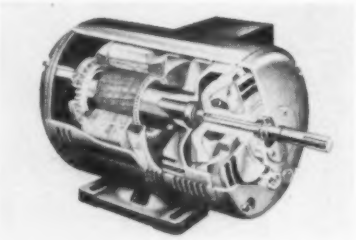
Heavy-duty packaged air compressor designed for 75-100 hp range

903 • Packaged air compressor in 75-100 hp range is said to approach efficiency and economy of larger, more powerful, slow-speed compressors. Unit, known as *PHE*, is an opposed-cylinder balanced design driven by a direct-connected induction motor for heavy duty operation.

Unit is arranged in single or multi-stages. Basic design is a two-stage unit for 80-125 psi, but other cylinder arrangements are available for higher pressures or for pumping stations.

PHE requires little floor space, simple foundation and minimum of piping and connections. It is suitable for factories, foundries, railroad shops, mines, powerhouses and large construction jobs. For full information request form 3155.

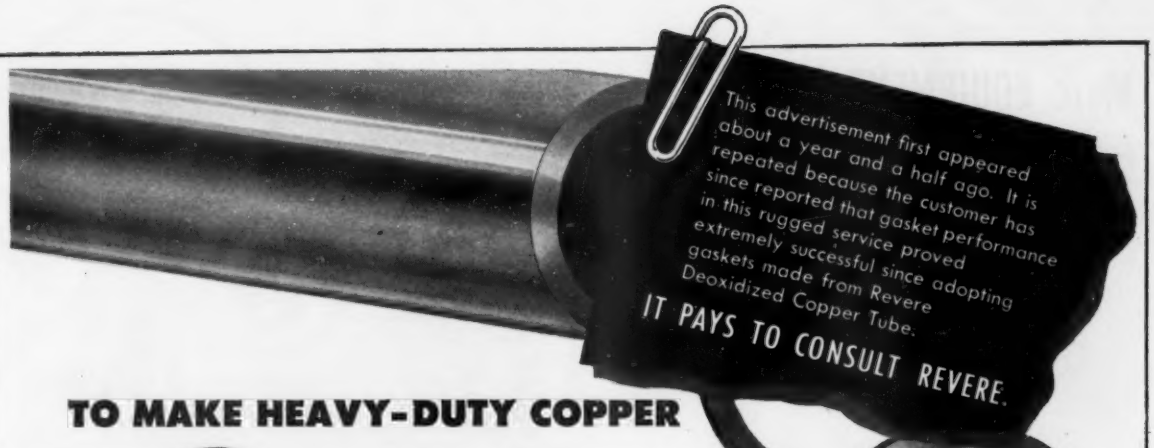
Ingersoll-Rand Co, 11 Broadway, New York 4, N. Y.



Power and speed control unit

919 • Combination power and speed control units are engineered to meet specific needs of fractional horsepower drives. Units are integral combination of ac constant-speed induction motors, eddy-current couplings, and electronic speed controls. Under constant torque or fan type load, unit may be operated continuously at any speed within limits of speed range. Electronic control insures speed stability of plus or minus 2% of top speed at any point within range. Drives are available in 115/220 v, single phase or 220/440 v, three phase; ¼, 1/3 and ½ hp at 1600 rpm, 10:1 constant torque speed range; ½ and ¾ hp at 3200 rpm, 20:1 range.

Dynamatic Div, Eaton Manufacturing Co, Kenosha, Wis.



This advertisement first appeared about a year and a half ago. It is repeated because the customer has since reported that gasket performance in this rugged service proved extremely successful since adopting gaskets made from Revere Deoxidized Copper Tube.

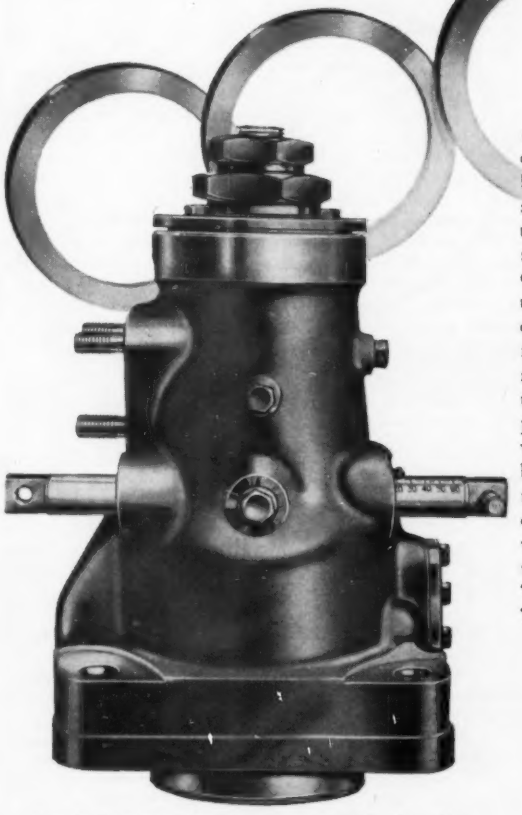
IT PAYS TO CONSULT REVERE.

TO MAKE HEAVY-DUTY COPPER

Gaskets

USE REVERE DEOXIDIZED

Tube!



Diesel Fuel Injection Pump, made by American Bosch Corp., Springfield, Mass., and gaskets made by cutting rings off 2" deoxidized copper tube.

• An important extra service rendered by Revere consists of collaboration in setting up specifications. This is valuable because there are many different Revere Metals, each with special characteristics. No one copper, for example, will serve to best advantage in every application. A case in point is the matter of copper gaskets for Diesel fuel injection pumps. Copper is of course an ideal metal for gaskets, and is widely used for that purpose. But for this special application, which copper and in what form? The pump is used on large engines for municipal generating plants. It weighs 186 pounds, and must produce the high pressure required to inject fuel near the top of the Diesel compression stroke. Naturally, the load is a pulsating one. American Bosch Corporation came to Revere with the problem. Our suggestion was that much scrap could be saved if the gaskets were made by cutting rings off copper tube, instead of stamping them from strip. This achieved a double purpose, since the tube is made of deoxidized copper, which is superior in this application to electrolytic. We are able to report that these recommendations proved successful. . . . This work was done by the Revere Technical Advisory Service. To get in touch with it, see the nearest Revere Sales Office.

REVERE

COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

230 Park Avenue, New York 17, N. Y.

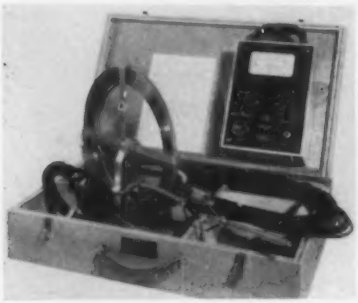
• • •

Mills: Baltimore, Md.; Chicago and Clinton, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Rome, N. Y.— Sales Offices in Principal Cities, Distributors Everywhere.

SEE "MEET THE PRESS" ON NBC TELEVISION, SUNDAYS

More EQUIPMENT NEWS

Begins on page 156



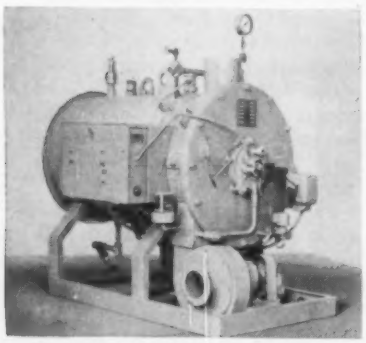
Scale thickness indicator

946 • Improved model of the *Turner* boiler tube scale thickness indicator is said to register accurately in tube bends and even while in motion. The indicator is an electrical instrument for measuring thickness of scale or other deposits on the inside of boiler tubes, water wall tubes or other straight or bent tubes or ducts of circular cross section.

The unit works on the magnetic induction principle and is independent of the material composition of the deposit. In operation, one person passes the probe head down the boiler or water wall tube from the upper header or drum by means of a steel tape, while a second person records scale thickness for each foot of travel. Thickness of deposits can be read to the nearest thousandth of an inch.

Available for tubes from 1½ to 4 in. ID, with special sizes on request. Uses 110 to 120 v, 60 cycle ac supply.

Haskins-Turner Co,
1617 Third St, Jackson, Mich.



Package boiler units

910 • Automatic "pocket-size" package boiler units are available in seven sizes from 15 to 60 hp for firing with light oil, gas or combination. Designated *Model TP* steam generator, these boilers are built in strict accordance with ASME and National Electrical Codes and are UL approved. Small dimensions, lower price and self-contained design make these units desirable for operations requiring smaller capacities, according to manufacturer. Request bulletin TP-1 for further details.

Ames Iron Works, Oswego, N. Y.

Combination welder and power unit offers simultaneous output

901 • Combination welder and auxiliary or standby power unit for maintenance work in construction and industrial plants features low cost, large capacity and simultaneous output of both welding and auxiliary current. *Weldanpower* is rated as a 200-amp welder and 4-kva continuous duty power unit. For intermittent standby power it is rated at 5 kva.

The machine supplies a wide range of ac current for maintenance welding on equipment and worn parts, hardfacing machine parts to resist wear and making replacement parts. Unit supplies 230/115-v, 60-cycle single phase ac standby power to operate pumps, power tools, grinders, saws, drills and lights.

Unit is an ac alternator powered by a 12-hp air-cooled gasoline engine. A four pole laminated steel rotor on which coils are wound is coupled to the engine shaft. Stator has two windings, one for welding circuit and one for power supply, so that both power sources are available simultaneously.

Accurate voltage control of output insures efficient operation of electrical equipment. Normal voltages are held constant regardless of load variations to prevent both over- and undervoltage.

The Lincoln Electric Co, Cleveland 17, Ohio

For more data on these items, use post cards p 165. Identify your request with item numbers.

Self-servicing television master antenna system

947 • Ampli-vision closed-circuit antenna system is said to "service itself." Any tube in the amplifier may fail without disturbing performance of the system on any TV channel. Unit is intended for hotels, apartment buildings, etc.

The new amplifier differs from normal units in that while each tube amplifies it, the signal is not passed from one tube to the next but from input, through each tube, to the output. If one or more tubes fail, actual amplification capability is reduced, but operation of the entire system continues. The tubes are in parallel along a pair of delay lines that defeat the normal tendency of paralleled tubes to reduce amplification because of interelectrode capacitances.

Industrial TV Utilities Co, Inc,
50 Church St, New York, N. Y.

V-link belting

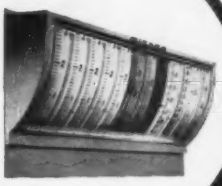
939 • Improved link belting, *Brammer Red*, incorporates a new rubber compound and special weave fabric. Manufacturer claims it has great resistance to stretch, more plies in each size, improved flexibility, greater resistance to shock, fatigue and abrasion. The red belting becomes the company's standard type, with oil-resistant being green, and static-conductive black.

Brammer Corp, 684 Broadway,
New York 12, N. Y.

CHECK THESE TOO . . .

Gear unit and motor mount . . **p 170**
Package-boiler tube expander . . **p 172**
Torque transmitting device . . . . **p 176**
Vibration safety-switch . . . . . **p 178**
Variable-speed drives . . . . . **p 182**
Industrial unit heaters . . . . . **p 190**

one of these



W-Gage for large boilers and remote indication

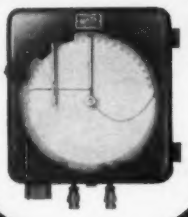
Hays gages

B-Gage for small boilers, combustion testing and air filters

will meet your

FOT-Gage for furnace pressure or fuel flow – air flow indication

LOW PRESSURE



OT-Recorder for draft or pressure

requirements

D-Gage for commercial, institutional boilers and industrial furnaces

Whether you need a draft gage for the largest steam generator, or a small portable gage for spot checking pressure conditions, first or last, it will pay you to talk to Hays, manufacturer of the most complete line of draft and low pressure gages.

Functional in styling, Hays gages have the features instrument men have always asked for—easy to read, accessible and extremely dependable.

The heart of all Hays low pressure gages is a diaphragm housed in cast metal. Diaphragms are easily replaceable in the field.

All Hays gages are guaranteed to withstand at least 100% over range without failure!

Why not talk to the people at Hays about low pressure gages for your applications—or write for complete details: *Bulletin 54-667-8.*

Automatic Combustion Control
Boiler Panels • CO_2 Recorders
Veriflow Meters and Veritrol
Gas Analyzers • Draft Gages
Combustion Test Sets
Electronic Oxygen Recorders
Electronic Flowmeters
Electronic Feed Water Controls
Miniature Remote Indicators

THE **hays** CORPORATION

MICHIGAN CITY 3, INDIANA

"You see POWELL VALVES everywhere!"

Not surprising when you realize that Powell makes more kinds of valves and has probably solved more valve problems than any other organization in the world. And this has been going on since 1846.

Wherever flow requires dependable control, there's the place for Powell Valves—available through distributors in principal cities. Made ⅛" to 30" and 125 pounds to 2500 pounds W. S. P. Bronze, iron, steel and corrosion resistant alloys. On problems, write direct to The Wm. Powell Company, Cincinnati 22, Ohio.

CONTROLS FOR THE LIFE LINES OF INDUSTRY

Powell Valves

108th year

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follow these easy steps

Preceding pages tell you what's new in plant equipment. Each item is numbered. For more details on any item, write its number here →

New free catalogs and bulletins are listed beginning on back of this page. To order those you want, write in their item numbers here →

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Power a McGraw-Hill Publication

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Company .....

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New York 36, N. Y.

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Reader Service Department
330 West 42nd Street
New York 36, N. Y.

AIR CONDITIONING, HEATING

1 **Air conditioning units,** floor or ceiling mounted for commercial and industrial applications. Photos, specs, dimensions in 8-page bulletin C-1190-B13B. Worthington Corp, Harrison, N. J.

2 **Backward curve fans,** *type J.* Photos, specs, construction data, charts and tables in 48-page bulletin 2500. Robinson Ventilating Co, Zelienople, Pa.

3 **Blast cleaning and dust control** equipment. Photos, diagrams, cutaways, specs of complete line. Two-color, 24-page bulletin 1210. Pangborn Corp, Hagerstown, Md.

4 **Air temperature** and moisture control. Photos, applications, specs of *type A* conditioner. Eight-page bulletin 122, Niagara Blower Co, 405 Lexington Ave, New York 17, N. Y.

5 **Exhaust fans,** direct-connected. Photos, performance charts, specs, application data in 8-page bulletin 509. M & E Manufacturing Co, 2571 Winthrop Ave, Indianapolis 5, Ind.

6 **Unit heaters** for steam or hot water. Horizontal, vertical units. Design, engr data, capacity tables, piping charts in 46-page bulletin 7517. American Blower Corp, Detroit 32, Mich.

7 **Heating systems** and controls. Describes five steam heating systems and full line of valves, traps, steam power specialties. Photos, diagrams in 20-page bulletin 110. Illinois Engineering Co, 2035 S Racine Ave, Chicago 8, Ill.

BOILERS AND AUXILIARIES

8 **Steam condensers.** Photos, sketches, engr data of condenser types and accessories in 24-page bulletin 19B7937. Allis-Chalmers Manufacturing Co, 952 S 70th St, Milwaukee, Wis.

9 **Steam generators.** Construction data, capacities, dimensions, photos of packaged units. Ten-page bulletin PSG-1, Henry Vogt Machine Co, 1000 W Ormsby St, Louisville 10, Ky.

10 **Power generation** and conversion in steel mills. Data on steam pressures and temperatures, size of turbine-generator sets, connections, etc in 8-page bulletin GER-892, General Electric Co, Schenectady 5, N. Y.

11 **Flow control unit** for boiler blow-off. Photos, applications, engr and operating data in 8-page bulletin. The Madden Corp, 1543 Morse Ave, Chicago 26, Ill.

CONTROLS

12 **Pneumatic operated control** for measurement and control of liquids. Photos, diagrams, dimensions and applications in 8-page bulletin 5421. General Filter Co, Ames, Iowa.

13 **Pneumatic controllers** for process variables. Photos, cutaways, schematic diagrams, specs in 12-page catalog 53-10. Fischer & Porter Co, 148 Jacksonville Rd, Hatboro, Pa.

14 **Microwave gas tube** to provide electronic control of microwave propagation. Diagrams, applications, specs in 6-page bulletin A-20. Roger White Electron Devices, Inc, Route 17 and Erie RR, Ramsey, N. J.

ELECTRICAL EQUIPMENT

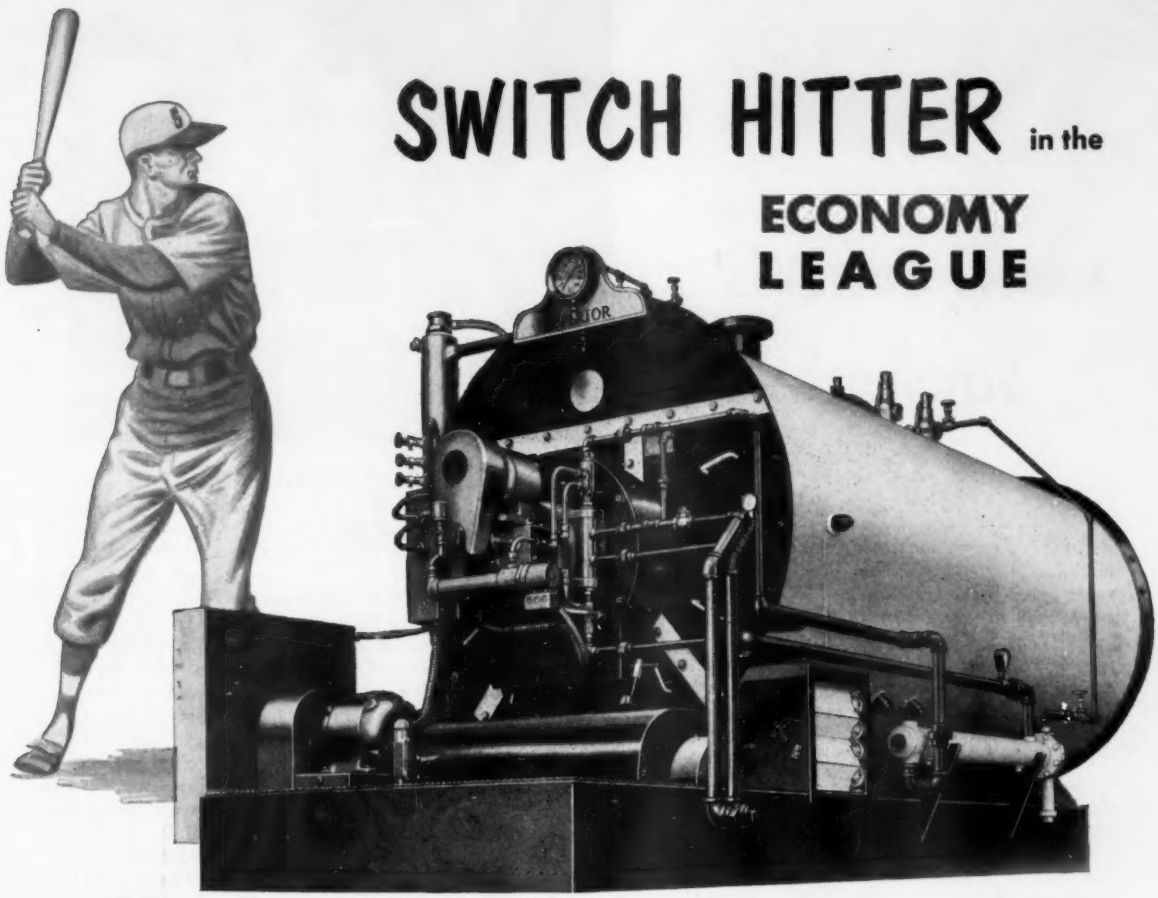
15 **Electrical installations.** Illustrated 44-page booklet describes recent projects of this construction-engineering firm. Patterson-Emerson-Comstock, Inc, 313 E Carson St, Pittsburgh 19, Pa.

16 **Power transformers.** Cites application and features of standardized single and three-phase units, 501 to 10,000 kva range. Two-color 40-page bulletin GEA-6108, General Electric Co, Schnectady 5, N. Y.

17 **Storage battery maintenance.** Pocket-sized, 8-page booklet explains seven basic rules. Form 5063, Exide Industrial Div, The Electric Storage Battery Co, Box 8109, Philadelphia 1, Pa.

(*Continued on page* 216)

SWITCH HITTER in the ECONOMY LEAGUE



SUPERIOR
STEAM GENERATORS

Just as the switch hitter changes his batting stance to take full advantage of the pitching situation, Superior Steam Generators change fuels to take advantage of the price situation. When equipped with combination gas/oil burners, Superior Steam Generators switch from one fuel to the other quickly, and without dismantling the equipment or interrupting the steam supply.

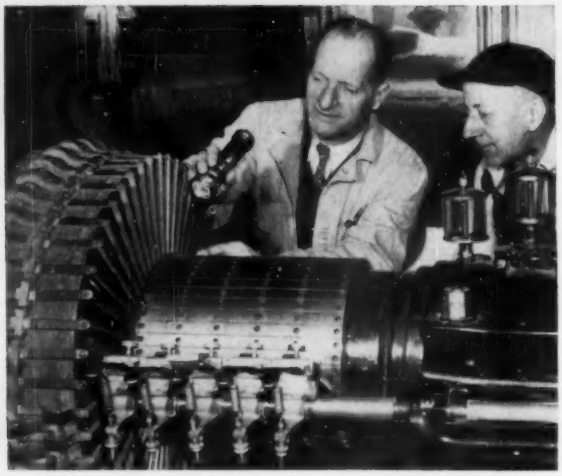
Superior Steam Generators are completely factory-assembled and fully tested prior to shipment for guaranteed performance exceeding 80% thermal efficiency, fully automatic . . . burning oil or gas . . . and are available in 18 sizes from 20 to 600 b.h.p. for pressures to 250 p.s.i. or for hot water. For complete details write for catalog 500-F.

for performance you can **BANK** *on*

SUPERIOR COMBUSTION INDUSTRIES INC.
TIMES TOWER, TIMES SQUARE, NEW YORK 36, N.Y.

SUPERIOR
STEAM GENERATORS

George Edwards' Scrapbook



DID YOU KNOW that Jumbo Dynamo shown here is the sole survivor of a fire that destroyed America's first central station, Pearl Street Station in New York City?

Detroit Edison's electrical-maintenance men Mike Meyer (right) and Albert Thomason check the wiring of this granddaddy of today's generators in its present home in Greenfield Village, just outside Detroit.

There it's housed in a precise replica of the old Edison Illuminating Co plant that once stood at Washington and State Streets and was Detroit's first central station. Rebuilt with its old boilers and engines by Henry Ford, this early station recalls the days back around 1896 when young Henry was its chief engineer and working in off hours on his first car.

Power from the old Edison generators will be used this year (75th anniversary of Edison's light) to light an immense 50,000-watt light. The three-foot-tall bulb will be on a high tower, and power used for the lamp alone will equal that turned out 70 years ago by the Edison central station for Detroit users.

If you haven't visited the Henry Ford Museum in Dearborn, Mich., you have a pleasant surprise coming. Old power equipment and buildings that once housed it have been faithfully reproduced at tremendous cost.

Retiring? For my money, Fred Annett has the right formula. After 35 years on POWER, *he 'retired' two years ago. The other day, he handed his 11th book manuscript to the McGraw-Hill Book Co.*

Fred has his old desk at the office and shows up every few days to answer his mail, meet visiting engineers and to prepare articles on a contributing basis. I understand he still receives as much mail at the office as he did when he was there full time.

Last time I visited New York, Fred told me that he is happier than ever, because he's still doing the things he likes best. But now he can do them in his own time, without pushing himself.

I can't see a man being chopped off from active work just because he reaches 65. If you want to do that and spend your days under a palm tree, that's the thing for you. Like Fred, I want to keep doing things I'm most useful in—so long as I'm not rushed.

A hobby is OK, but after years of grinding out useful work, whether it's keeping up with peak production or meeting deadlines, I for one won't be happy making toys. Incidentally, what are some of you older power engineers planning for retirement? Let me know. Perhaps we can kick a few good ideas around on this page.

' ' '

People, like boats, toot loudest when they're in a heavy fog, says one of our readers.

' ' '

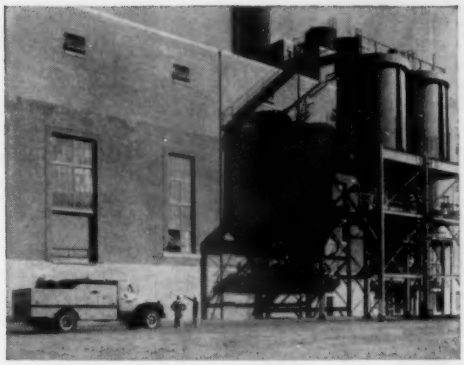
Sometime, when you're feeling important,
Sometime, when your ego's in bloom,
Sometime, when you take it for granted,
You're the best qualified in the room;
Sometime when you feel that your going
Would leave an unfillable hole,
Just follow this simple instruction,
And see how it humbles your soul.
Take a bucket and fill it with water,
Put your hand in it, up to the wrist;
Pull it out; and the hole that's remaining,
Is a measure of how you'll be missed.
You may splash all you please, when you enter,
You can stir up the water galore,
But stop, and you'll find in a minute,
That it looks quite the same as before.
The moral in this quaint example,
Is do just the best you can,
Be proud of yourself, but remember,
There's no indispensable man. —Anonymous

Ever think of your competitors as your best friends? Look at it this way. Your friends won't tell you your faults, but your competitors advertise your faults to the world. That makes you try to improve yourself—or your product. Suppose you had no competition in your work, your product or your sports. You'd probably be so darned satisfied and lazy that you'd still be living in the horse-and-buggy era.

Because you know that new guy the boss hired last month is on his toes, you're going to work like hell to beat him to the next promotion. Because you know that new pump brought out by your competitor is better than yours, you've been working on one that promises to go it one better—and so it goes. Fact is, the U.S. wouldn't be out-producing the world in everything from tin cans to power if it weren't for some pretty keen competition—and neither would you be where you are today. Yup, your competitor is OK.

George Edwards
Engineer

300,000 PPH BOILER CLEANED CHEMICALLY IN ONE DAY!



Dowell engineers bring solvents to the job in truck-mounted tanks, along with all pumping and control equipment. They apply the chemicals as necessary—by filling, spraying, jetting, cascading or vaporizing.

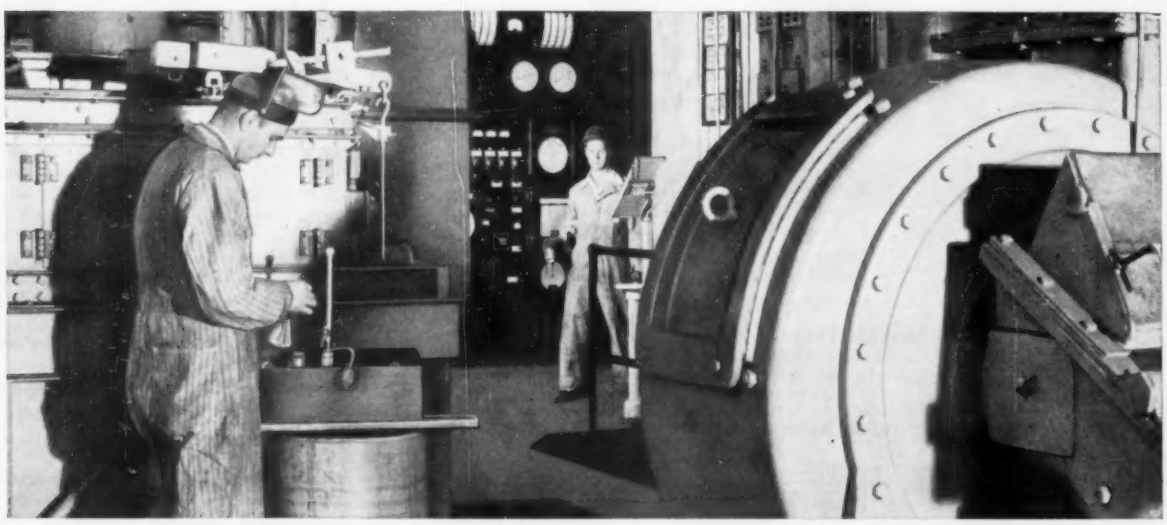
Comparative cases showed DOWELL cleaning took less time . . . removed more scale than mechanical methods

This is a case history on a 300,000 pound per hour boiler in a refinery. A routine inspection showed that iron oxide and silicate scale fouled the tubes. Dowell engineers cleaned the boiler with chemical solvents in less than 22 hours.

Dowell chemical cleaning is the standard method of removing deposits from boilers in this plant. Comparative tests showed that the chemical method was both faster and more thorough than the mechanical means previously used. The operator was surprised at the relatively large amounts of scale and sludge removed by chemical cleaning. Dowell has cleaned 25 of the 27 boilers in this plant. Several have been cleaned as many as three times on an annual basis.

Dowell liquid solvents go wherever steam and water flow, reaching surfaces inaccessible to other methods. No special scaffolding is required. *Dismantling and down-time are kept to a minimum.* Often, equipment may be cleaned while in operation.

Perhaps chemical cleaning could improve the efficiency of equipment in your plant—for example, heat exchangers, piping systems, tanks and process towers. For complete information and estimates, call the nearest of more than 130 Dowell offices, or write directly to Dept. I-23, DOWELL INCORPORATED, TULSA 1, OKLAHOMA.

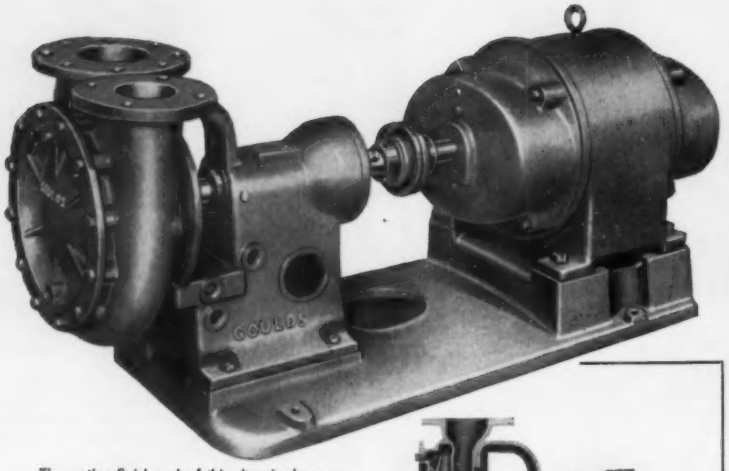


DOWELL SERVICE

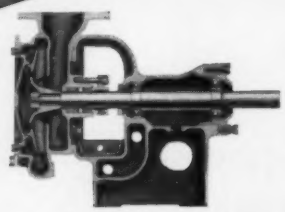
chemical cleaning service for industry

DOWELL

A SERVICE SUBSIDIARY OF THE DOW CHEMICAL COMPANY



The entire fluid end of this chemical pump is available in any of the following metals: 316, Gould-A-Loy 20, 304, all iron, all bronze or bronze fitted, all iron with stainless trim. Nine sizes ranging from ¾" to 3"; capacities up to 720 GPM; heads to 200 ft.



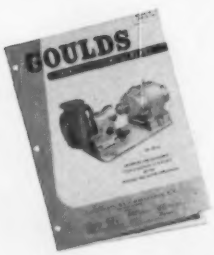
You get a lot for your money

in this new chemical pump

New design features of the Goulds Fig. 3715 centrifugal pump offer you special operating and maintenance advantages in handling acids, alkaline liquors, and slurries.

The liquid end of the Fig. 3715 is the same as in its immediate ancestor, the Fig. 3705. Thousands of severe-service applications have shown us no way to improve it. But the support head is completely new. It's a sturdy, box-type design with water cooling which raises the maximum liquid temperature limitation to 350° F. It has grease-lubricated standard bearings with grease relief that helps prevent over-lubrication . . . and a simple, positive external arrangement for adjusting impeller clearance without any dismantling.

With the stuffing box under suction pressure only, you will have infrequent need for re-packing and a new freedom from excessive leakage. You can inspect and clean the interior, and you can remove or replace the impeller, without disturbing suction and discharge connections.



Bulletin 725.4 describes *all* the operating and maintenance advantages of the Goulds Fig. 3715 chemical pump. It defines the extensive standardization this design accomplishes for simplifying your parts inventory. It gives you detailed performance curves. We will be glad to send you a copy. Just write for Bulletin 725.4.

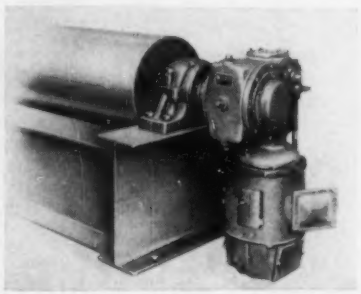
MEMBER

Goulds PUMPS INC.
Seneca Falls
New York

ATLANTA • BOSTON • CHICAGO • HOUSTON • NEW YORK • PHILADELPHIA
PITTSBURGH • TULSA

More EQUIPMENT NEWS

Begins on page 156

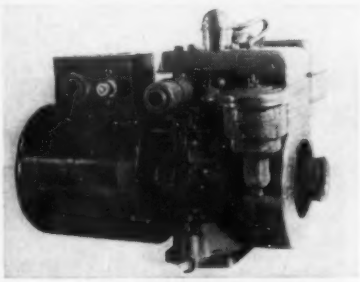


Gear unit and motor mount

929 • Compact *Floating GearMotoR* mounts directly on driven shaft eliminating long lines of shafting and open gearing or complicated gearmotor drives. There can be no misalignment between power unit and driven shaft as power unit becomes integral part of driven shaft, according to manufacturer. Simple torque arm prevents gear unit from rotating around shaft. Gearing is proportioned for 300% peak loading over normal ratings. Range of output speeds is from 8 to 800 rpm with integral electric motors ranging from 1 to 15 hp. Request 8-page catalog F-54.

Philadelphia Gear Works, Erie Ave & G St, Philadelphia 34, Pa.

For more data on these items, use post cards p 165. Identify your request with item number.



New 400-w electric plant

907 • Series of 400-w electric plants, *Models 08-B* and *08-ES* offer unusual fuel economy achieved largely through comparatively slow engine speed of 1800 rpm, according to manufacturer. Four pole generator has capacity of 400-450 w, 110-120 v, ac. While of the heavy-duty type, weight of plant is only 78 lbs. Unit is completely self-contained and includes gas tank, muffler and air cleaner. Request bulletin DZE-I.

Universal Motor Co, 522 Universal Dr, Oshkosh, Wisconsin

Fluid power cylinder

965 • A fluid power cylinder of unusually large capacity to size ratio incorporates a new cushion design with positive, easy adjustment, and is said to reduce friction to a minimum consistent with good sealing. The unit conforms to J I C standards. Write for catalog, model 750.

Hanna Engineering Works, 1741 Elston Ave, Chicago 22, Ill.

(*More Equipment News on page* 172)

1879-1954 DIAMOND JUBILEE OF THE FIRST INCANDESCENT LIGHT

Oil for Edison's Magic Lamp_

and for the Power Plants that Light America's Cities Today!

SEVENTY-FIVE years ago, when the incandescent lamp was born, Thomas Edison relied on a Socony-Vacuum oil to protect the generating equipment that provided the electricity. Today, to commemorate the diamond jubilee of light, Edison's original equipment has been re-activated at the Henry Ford Museum and Greenfield Village near Detroit. And once again a Socony-Vacuum oil has been chosen to protect it.

There is good reason for this choice. Socony-Vacuum lubricants for power plants have been the standard of quality for over 75 years. In fact, more turbines of 5,000 kw and over are lubricated by Socony-Vacuum than by any other oil company.

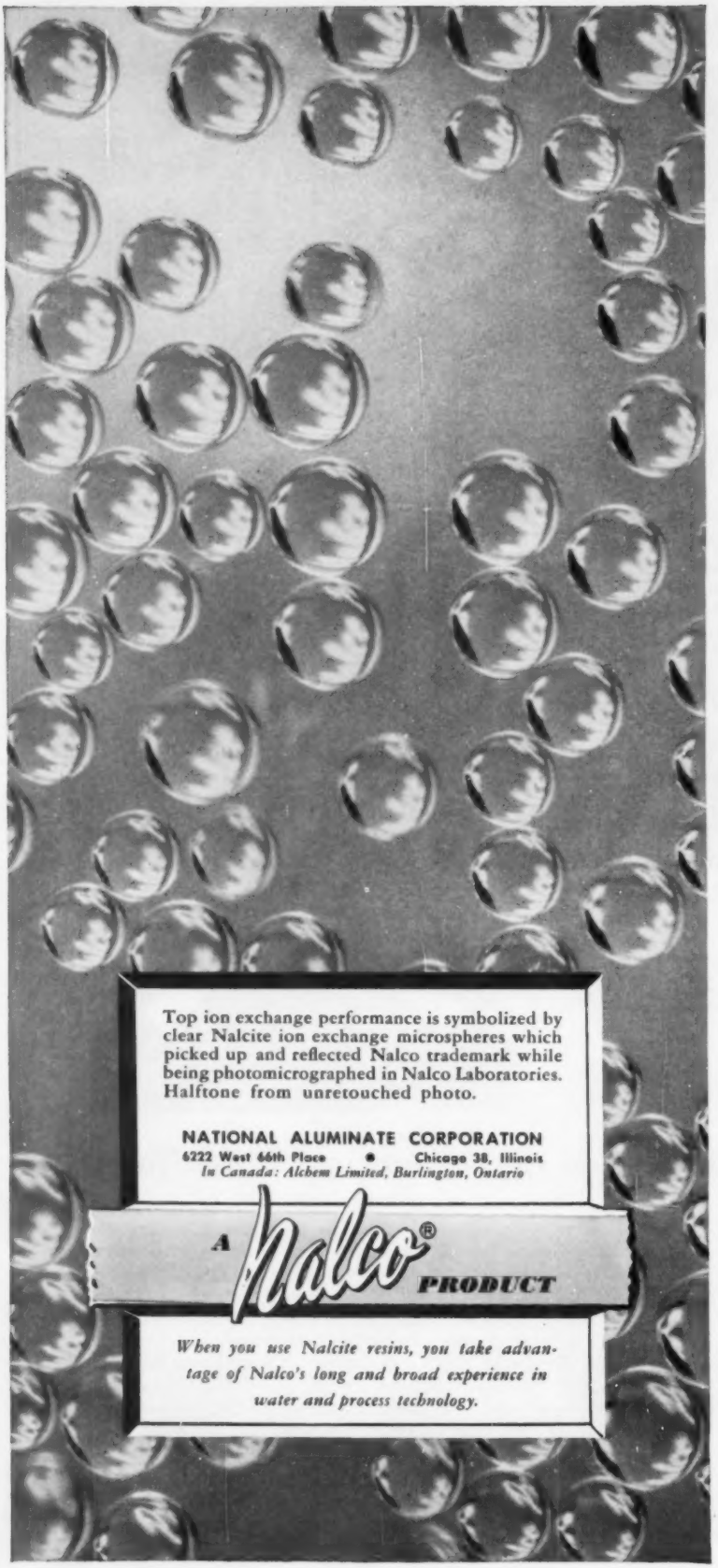
We are proud that, during these past 75 years, we were able to play a part in bringing the magic of Edison's lamp—and of electricity—to people throughout the world.

SOCONY-VACUUM

SOCONY-VACUUM OIL COMPANY, INC.

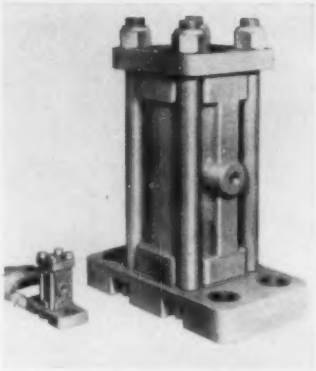
and Affiliates:

MAGNOLIA PETROLEUM COMPANY · GENERAL PETROLEUM CORPORATION


Top ion exchange performance is symbolized by clear Nalcite ion exchange microspheres which picked up and reflected Nalco trademark while being photomicrographed in Nalco Laboratories. Halftone from unretouched photo.
NATIONAL ALUMINATE CORPORATION
6222 West 66th Place • Chicago 38, Illinois
In Canada: Alchem Limited, Burlington, Ontario
A Nalco® PRODUCT
When you use Nalcite resins, you take advantage of Nalco's long and broad experience in water and process technology.

More EQUIPMENT NEWS

Begins on page 156

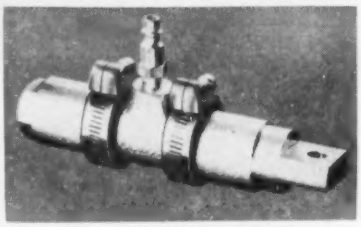


Bin and hopper vibrators

928 • Two air vibrators, 1-in. and 5-in. piston diameter *Type F*, bring manufacturer's line of bin vibrators to eight sizes. Both units operate on 25 to 100 psig continuous line pressure, with maximum efficiency at 80 psig. Units are designed for continuous or intermittent operation. To simplify installation, vibrator, operating valve, automatic lubricator, mounting base plate, hose and fittings are obtainable in complete kit form.

The Cleveland Vibrator Co, 2828 Clinton Ave, Cleveland 13, Ohio

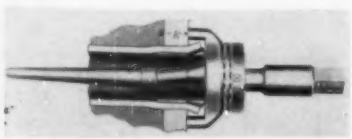
For more data on these items, use post cards p 165. Identify your request with item number.



Small pneumatic vibrators

908 • Noiseless type, ⅝ and ¾-in. muffler-equipped pneumatic vibrators have been designed for use in areas where low noise level is a major requirement. Powerful vibrating action is achieved by a piston that reciprocates in a cylindrical passage when compressed air is introduced alternately to opposite ends of cylinder. It delivers to 5000 strokes per minute and operates on 30 to 140 psi line pressure. Vibrator is 6¾-in. long, weighs 2½-lbs.

Vibron Div, Burgess-Sterbentz Corp, 3790 W 150th St, Cleveland 11, Ohio



Package-boiler tube expander

950 • Modern parallel rolling and flaring type tube expander has guard that holds the flare roll back while tube is being rolled and flared into tube sheet. This feature

Super Tough

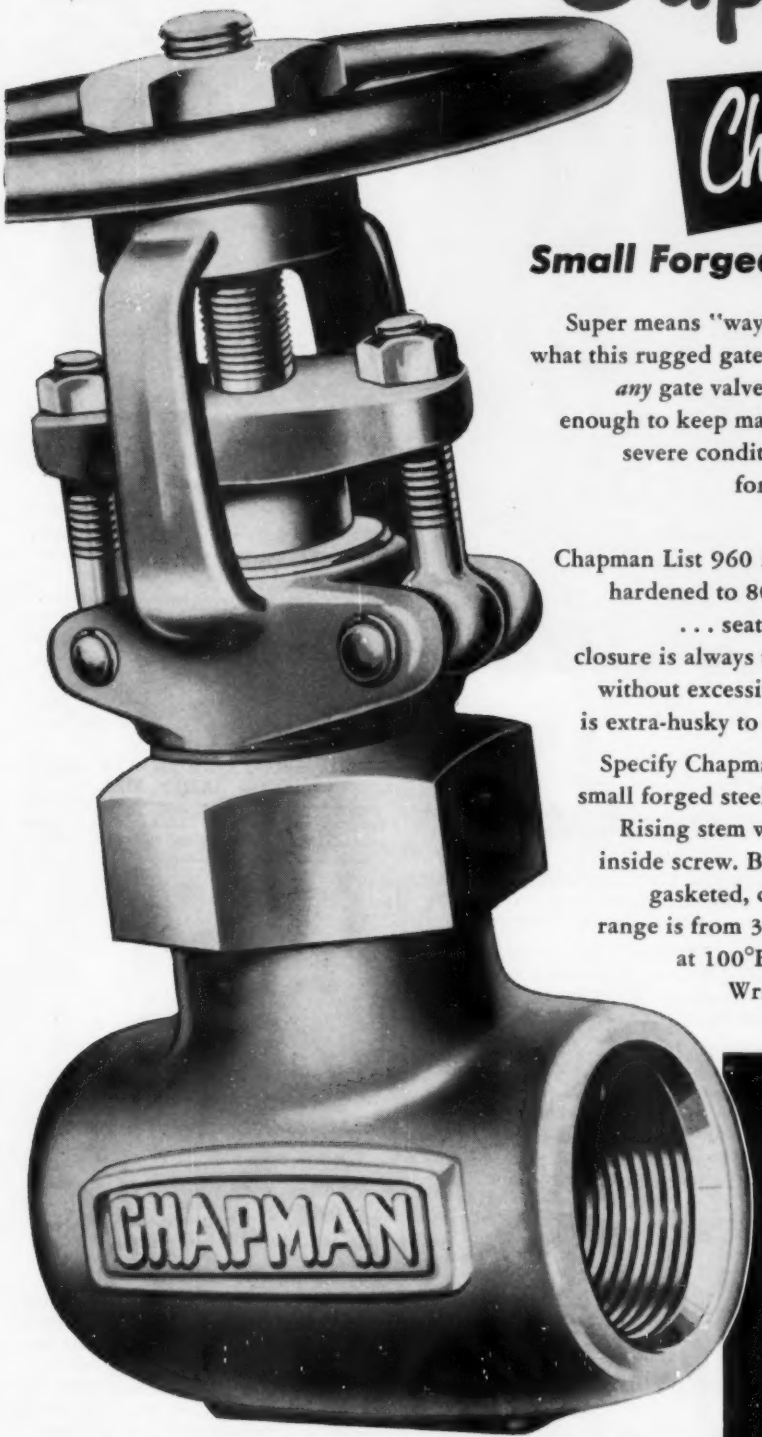
Chapman List 960

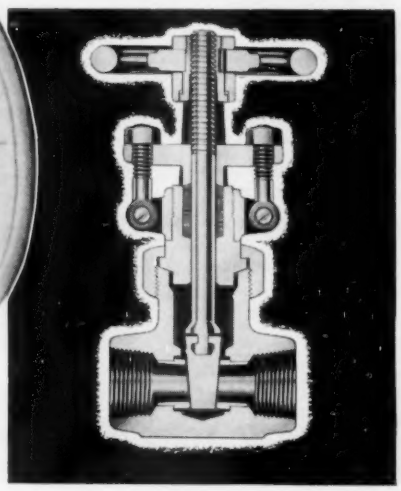
Small Forged Steel Gate Valve

Super means "way beyond the ordinary" and that's just what this rugged gate valve is . . . it's tough enough to lick *any* gate valve problem in its range . . . dependable enough to keep maintenance costs down under the most severe conditions. That's why List 960 is specified for more different applications than any other valve of its kind.

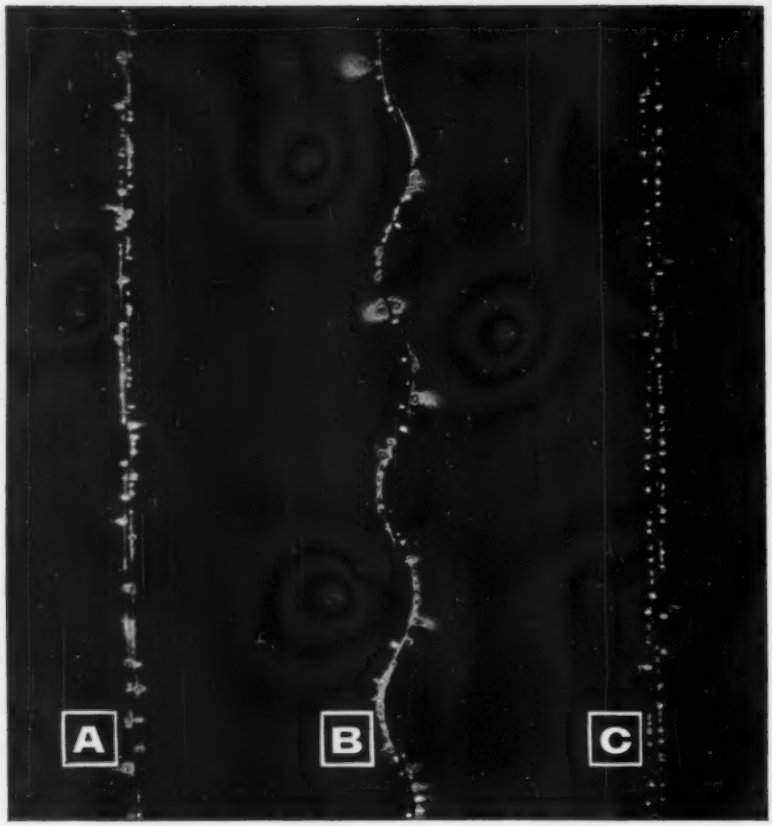
Chapman List 960 is tough because . . . wedge faces are hardened to 800 Brinell, so they won't seize or gall . . . seat rings are hardened stainless steel, so closure is always tight and operation is always smooth, without excessive wear . . . stem-and-gate connection is extra-husky to stand up under even unusual stresses.

Specify Chapman List 960 for every use you have for small forged steel gate valves. In sizes from ¼" to 2". Rising stem with yoke (shown) or rising stem with inside screw. Bonnet joint is either metal to metal or gasketed, depending upon application. Pressure range is from 380 pounds at 1000°F to 2000 pounds at 100°F. For higher ratings, specify List 990. Write today for your copy of Catalog 10.





The CHAPMAN Valve Manufacturing Co.
INDIAN ORCHARD, MASSACHUSETTS



The A B C of Electric Precipitation

The efficiency of *any* electric precipitator depends on the quality of the corona emission from the electrode, for it is this emission that 'charges' the dust.

Pictured above are the three most frequently used electrodes for doing this job. You can see the quality of the corona for yourself. We'll be glad to give you an actual demonstration.

Other precipitators use electrodes A and C which give off only fair emission. Use of fine wire (to increase emission) leads to structural weakness. Use of heavy wire (to give strength) means poor emission.

The exclusive Buell Spiralectrode (B) combines strength with peak emission.

The outstanding on-the-job performance of the new Buell Spiralectrode is typical of the advances made by Buell Engineers. Continuous-cycle rapping, for example, proved in service for 20 years has *never* caused "puffing".

Buell has consistently led the way to greater efficiency, through a long series of technical discoveries and advances, in all types of dust collection.

Get all the facts. Send for our informative brochure—The Collection and Recovery of Industrial Dusts. It explains all three Buell Systems of industrial dust collection. Send for your copy today.

Write Dept. 50-I, Buell Engineering Co., 70 Pine Street, New York 5, N. Y.

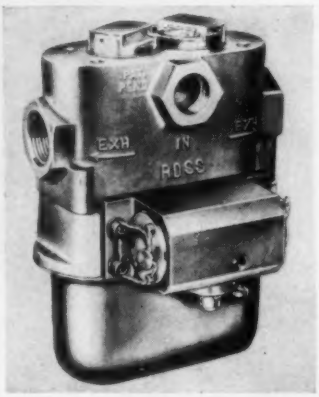
buell®

MECHANICAL ELECTRICAL *20 Years of Engineered Efficiency in* **DUST COLLECTION SYSTEMS**

More EQUIPMENT NEWS

Begins on page 156

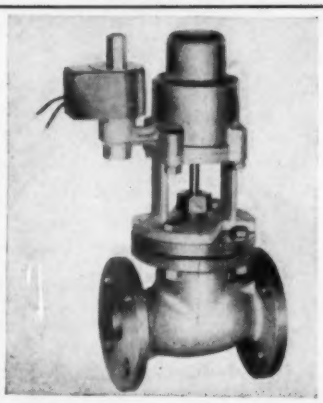
helps when rolling tubes closely spaced in thin tube sheets. Ball thrust bearing between guard and tube expander frame reduces friction. Similar unit available for re-rolling leaking tubes after beading.
The Gustav Wiedeke Co, Dayton, Ohio



Air control valve

913 • *Lifeguard* air control valve provides exceptional degree of safety in press operation, according to manufacturer. A safety unit attached to pilot section casting cuts off air supply to pilot section in event of failure of any valve part. Valve cannot be actuated again until proper adjustments or replacements are made. Main valve pressures range from 30 to 125 psig air, with pilot pressure of 40 to 125 psig air. Maximum temperature is 175 F. Weight is 14 lbs and inlet pipe size ¾ in.
Ross Operating Valve Co, 134 E Golden Gate Ave, Detroit, Mich.

For more data on these items, use post cards p 165. Identify your request with item number.

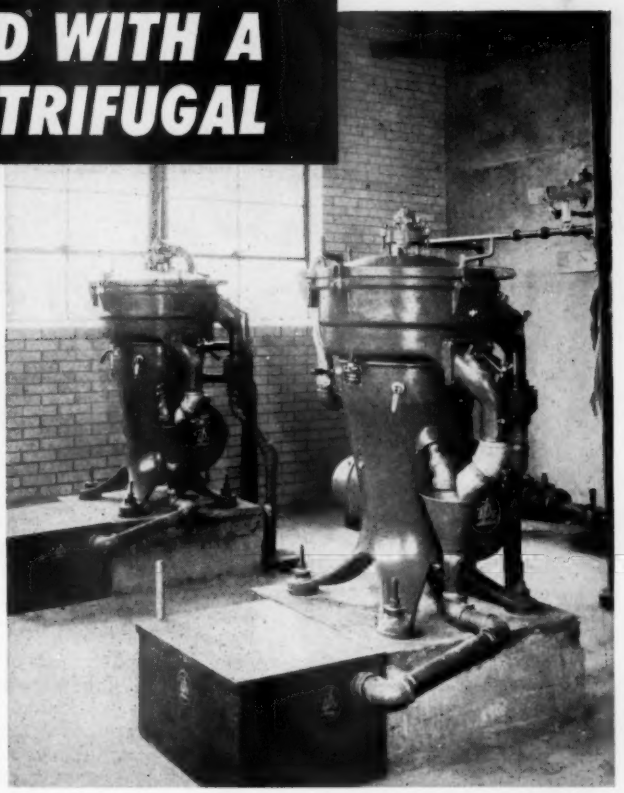


Corrosion resistant valves

909 • Cylinder-operated solenoid valves are designed for handling corrosive gases and liquids. Flexibility in construction permits choice of body materials to suit fluid controlled. Standard valve is suitable for either normally open or normally closed operation. Available with standard, watertight or explosion proof solenoid enclosures.
Automatic Switch Co, 391 Lakeside Ave, Orange, N. J.

(*More Equipment News on page* 176)

TO CUT FUEL COSTS..... BURN RESIDUALS, PURIFIED WITH A DE LAVAL CENTRIFUGAL



Many diesel-powered plants, ashore and afloat, are successfully burning heavy fuels with resulting large economies*.

They are purifying the residuals with De Laval Oil Purifiers—the most effective means ever devised for the purpose, as proved by efficiency comparison tests.

De Laval Oil Purifiers remove a *maximum* amount of incombustible solids—and do it at constant operating efficiency.

It will pay you to investigate the profit possibilities of burning a less costly fuel, purifying it the *De Laval* way. Write for complete information.

THE DE LAVAL SEPARATOR COMPANY
Poughkeepsie, New York ● 427 Randolph St., Chicago 6
DE LAVAL PACIFIC CO., 61 Beale St., San Francisco 5

***FOR EXAMPLE...**

The Keystone Heights, Florida, plant of the Clay Electric Co-op burns straight residual fuels ranging in viscosity from 110 to 166 Furol at 122° F. and in API gravity from 13.5 to 9.4, running them through a De Laval Purifier. The savings, says the Chief Engineer, amount to as much as *$4,500 per month.*

DE LAVAL
HEAVY OIL PURIFIERS

BIDDLE *Instrument News*

NEW PRODUCT

Biddle Motor and Phase Rotation Tester

(Dual Purpose)

With it you can

- ***Determine*** **the direction of rotation of electric motors before they are connected to the line.**
- ***Determine*** **the phase rotation or sequence of energized power circuits.**

Here is a positive means for determining which motor leads must be connected to certain conductors of a supply system to insure that the motor will rotate in a prescribed direction when energized.

This device will permit the electrical contractor or industrial maintenance electrician to permanently connect and tape the terminals of the motor being installed, without having to first energize the motor by a temporary "hook-up" from a power source, if available, to determine its rotation.

The Biddle Motor Rotation and Phase Tester eliminates the need for temporary connections which can be time consuming, costly, and quite hazardous, particularly where many large high-voltage motors are involved.

Certain types of drives should not be moved even a few degrees in the wrong direction. In such cases the temporary "hook-up" or trial method, having a fifty-fifty chance of being wrong, can do serious harm.

Even in the case of new motors with tagged leads, there is the possibility of human error in attaching the lead markers or of their becoming detached in shipment.

Incidentally, there are two other important uses for this unique testing device. It can determine the polarity of power and instrument transformers, and it can be used as a continuity tester in checking electrical circuits.

Housed in a sturdy oak case 12¼ in. x 8¼ in. x 4¼ in. this compact unit weighs approximately 10 pounds and is supplied complete with 3 line and 3 motor leads which store in the compartments either side of the instrument panel.

For complete details write for ***Bulletin 80-P***

8-416

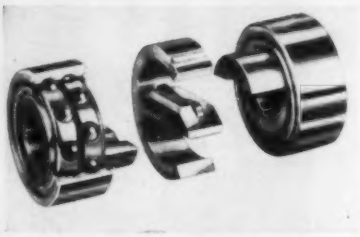
JAMES G. BIDDLE CO.

- ELECTRICAL TESTING INSTRUMENTS
- SPEED MEASURING INSTRUMENTS
- LABORATORY & SCIENTIFIC EQUIPMENT

1316 ARCH STREET
PHILADELPHIA 7, PA.

More EQUIPMENT NEWS

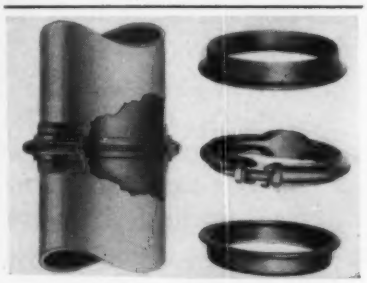
Begins on page 156



Torque transmitting device

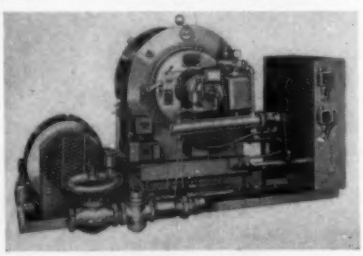
917 • Device for transmitting torque positively prevents reverse torque action, according to manufacturer. Unit transmits torque in both clockwise and counterclockwise rotation and can be used to lock a driven mechanism in any angular position. Called *Nobak*, the device can be used in all types of vehicles, hoists, cranes, conveyors, actuator mechanisms and in other equipment requiring positive angular positioning and protection against reverse torque. Four-page bulletin available.
Ahlberg Bearing Co, 3025 W 47th St, Chicago, Illinois

For more data on these items, use post cards p 165. Identify your request with item number.



Steel tubing joint

951 • Quick assembly tubing joint for 1- to 5-in. od tubing is designed for coupling exhaust manifolds and exhaust piping joints, operating at normal internal combustion engine temperature and low internal static pressures. Available in stainless or cold rolled steel the joint features ease of application, economy and speedy disconnect.
Marman Products Co, Exposition & Sepulveda Blvds, Los Angeles, Calif.



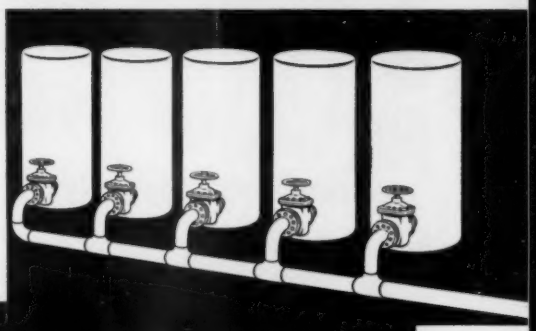
Forced-draft packaged burner

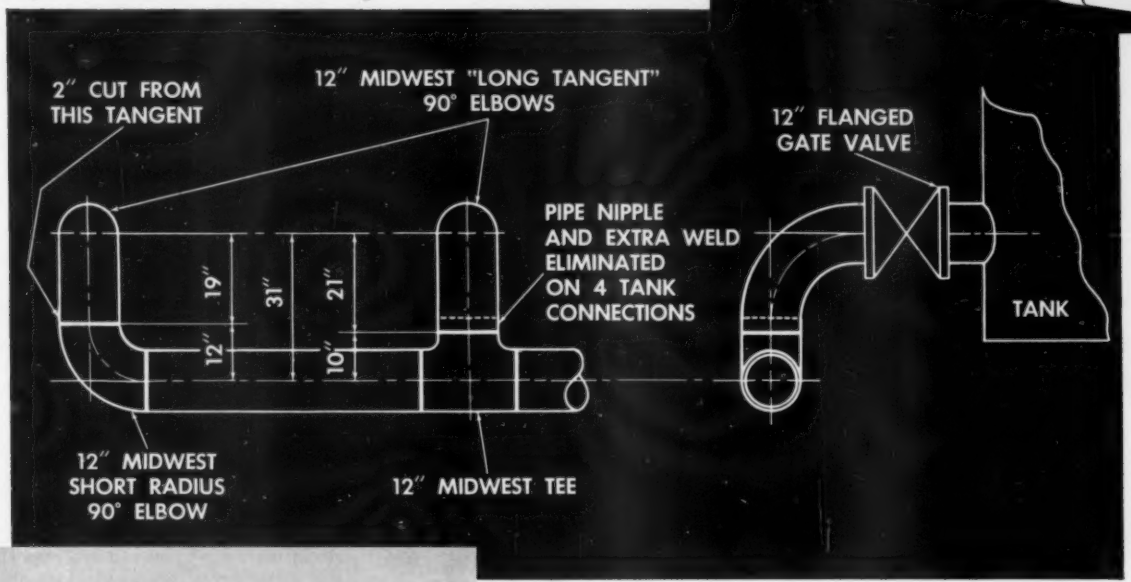
952 • This burner is built to specifications for Scotch marine boilers and other pressurized-operation applications for industrial-commercial use. Unit can be selected to burn any grade of fuel oil from No. 2 to No. 6 Bunker C, and high or low-pres-

MIDWEST "LONG TANGENT" ELBOWS

SAVED $156.20

On This Welding Piping





MIDWEST "LONG TANGENT" ELBOWS COST NO MORE THAN OTHER ELBOWS

The Problem:

To connect the five tanks shown in the sketch at top to a common 12" header.

The Difficulty:

The center-to-outlet dimension of the 4—12" tees is only 10", while the shortest elbow available measures 12" center-to-end, Thus, if standard long radius elbows are used next to the five tank valves, four short nipples and four extra 12" welds would be required.

The Solution:

By using Midwest "Long Tangent" elbows as shown in the blueprint, the expense of the four extra nipples and welds was eliminated at the cost of just one cut! The actual net savings made by "Long Tangent" elbows on this job was $156.20.

Remember—Midwest "Long Tangent" elbows cost no more than regular elbows! For further information, write for Catalog 54.

MIDWEST PIPING COMPANY, INC.

Main Office, 1450 South Second St., St. Louis 4, Missouri

PLANTS: ST. LOUIS, PASSAIC, LOS ANGELES, and BOSTON

SALES OFFICES: NEW YORK 7—50 CHURCH ST. • LOS ANGELES 33—520 ANDERSON ST.
BOSTON 27—426 FIRST ST. • CHICAGO 3—79 WEST MONROE ST.
CLEVELAND 14—616 ST. CLAIR AVE. • HOUSTON 2—1213 CAPITOL AVE.
TULSA 3—224 WRIGHT BLDG.

6820

MIDWEST WELDING FITTINGS IMPROVE PIPING DESIGN AND REDUCE COSTS

LATTICE BRAID* Packing

remains soft and flexible— gives 3 years service on ammonia valves at Terre Haute Brewery

*Registered Trademark. *Only* Garlock makes LATTICE BRAID rod and shaft packings.

"LATTICE BRAID is the best all-purpose packing we've ever used," reports Irving Hayworth, Chief Engineer at Terre Haute Brewery. "LATTICE BRAID gives us 3 years service on valves handling ammonia. This compares with 6 months service which we would usually receive from other packings. In addition, our men now use LATTICE BRAID packing on every cold water pump in the brewery."

Put Garlock LATTICE BRAID Packing to work for your company. All the braided strands of this unique packing are lattice linked together into one structural unit. The strands hold together even when the packing is worn far beyond the limits of wear of ordinary braided packings.

LATTICE BRAID is made from flax, cotton, asbestos, wire-inserted asbestos, Teflon, and asbestos with Teflon impregnation—for various types of services.

Get all the facts about LATTICE BRAID *Packings. Contact your Garlock representative or write for new folder AD-131.*

THE GARLOCK PACKING COMPANY, PALMYRA, NEW YORK

Sales Offices and Warehouses: Baltimore • Birmingham • Boston • Buffalo • Chicago • Cincinnati • Cleveland Denver • Detroit • Houston • Los Angeles • New Orleans • New York City • Palmyra (N.Y.) • Philadelphia Pittsburgh • Portland (Oregon) • Salt Lake City • San Francisco • St. Louis • Seattle • Spokane • Tulsa.

In Canada: The Garlock Packing Company of Canada Ltd., Toronto, Ont.

GARLOCK LATTICE BRAID PACKING

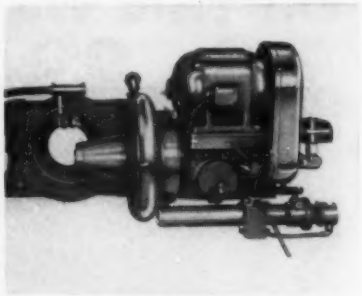
More EQUIPMENT NEWS

Begins on page 156

sure gas, or a combination of oil and gas.

Complete package includes burner, forced-draft fan, windbox, control panel, ignition and electronic safeguard system. Unit is ready for use when steam, water, electrical and fuel connections have been made. Catalog Unit Y.

Ray Oil Burner Co, 1301 San Jose Ave, San Francisco 12, Calif.



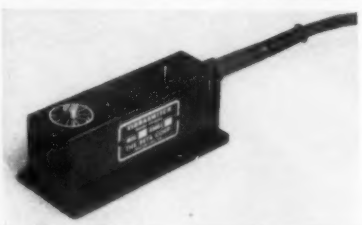
Rotary oil burner

953 • Horizontal rotary heavy oil burner *Model BHE* integrates the combustion system, patented *Voluvalve* with equalizing valve and low density electric oil preheater. Available with or without a panel box containing control assembly.

Unit is designed for preheated residual No. 6 fuel of viscosity between 45 and 300 SSF at 122 F. Capacities range from 15 to 175 gph. Equalizing valve built into the fuel pump reservoir greatly improves automatic starts and combustion at all firing rates, manufacturer states. It also reduces the noise caused by burning heavier No. 6 oils at too low temperature. Unit can employ a low density electric heater in place of a standard heater.

Preferred Utilities Mfg Corp, 1860 Broadway, New York, N. Y.

For more data on these items, use post cards p 165. Identify your request with item number.



Vibration safety-switch

934 • *Vibraswitch* may be used as a protective monitoring switch to sound warning or shut down a machine if vibration exceeds a preadjusted amount. Device may be used on rotating equipment including compressors, turbines, internal combustion engines. In plants where machines are automatically controlled, use of such a device may prevent machine damage by setting off warning or shutting down unit when vibration increases above a safe value. Bulletin 500-1.

The Beta Corp, Box 8625, Richmond 26, Va.

(*More Equipment News on page* 180)

Here's why the Ljungstrom saves fuel...improves boiler performance

1. Saves Fuel – Savings are roughly 1% for every 45-50°F of preheat, since this heat has been recovered in usable form from flue gases.

2. Increases Boiler Output – Preheating combustion air increases boiler furnace temperature. Heat absorption into boiler tubes increases at the same time, raising the unit's capacity to produce steam.

3. Increases Boiler Reliability – Preheating leads to more complete combustion of fuel; therefore, less slagging. By burning fuel more completely, it helps boilers stay on the line longer. Furthermore, gases to dust recovery units are cleaner.

4. Permits Use of Lower Grade Fuels – Saw and paper mill refuse, wood, lignites, peat, bagasse and similar low-grade fuels become commercially practical when preheated combustion air is used.

The Ljungstrom® Air Preheater . . . used in seven out of ten large boiler installations—is the most compact, reliable and versatile preheater available. Installed in a boiler, it leads to the four well-known advantages listed at the left.

Remember: the ability to deliver these important benefits in full measure is an important reason why more than twice as many Ljungstrom Air Preheaters are specified for large boilers than all other types combined.

WHEREVER YOU BURN FUEL, YOU NEED LJUNGSTROM

The Air Preheater Corporation 60 East 42nd Street, New York 17, N. Y.

Water Conservation starts *here*

Take the first step toward efficient water utilization . . . use BUILDERS PROPELOFLO METERS to find out *where* water is used and *how much*. Address . . .
Builders-Providence, Inc.
(Division of B-I-F Industries, Inc.)
354 Harris Ave., Providence 1, R. I.
for free Propeloflo Bulletin.

BUILDERS-PROVIDENCE
DIVISION OF B-I-F INDUSTRIES, INC.
BUILDERS IRON FOUNDRY • PROPORTIONEERS, INC. • OMEGA MACHINE CO.
METERS FEEDERS CONTROLS

More EQUIPMENT NEWS

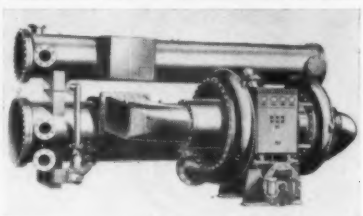
Begins on page 156

Cartridge type demineralizer

954 • Small-capacity demineralizer works on water under pressure so it can be delivered to remote point. Wall mounted unit can be connected into any water line. Replaceable resin cartridge eliminates regeneration with acid or caustic solutions. Unit handles flows from 5 to 25 gph with no heating or cooling water. Cartridges must be changed when pilot light goes out.

Barnstead Still & Sterilizer Co, 101 Lanesville Terrace, Forest Hills, Boston 31, Mass.

For more data on these items, use post cards p 165. Identify your request with item number.



Water chillers

955 • Three large size *CenTraVac* water chillers for comfort or process air conditioning extend manufacturer's line to 8 sizes from 45 to 400 tons capacity. Hermetic centrifugal compressor automatically matches power consumption to load variations from 100 to 10% of compressor capacity. Power input is limited to actual cooling requirements, reducing power costs. Elimination of gear box or belt drive results in up to 5% further power savings, it is claimed. Bulletin DS 399.

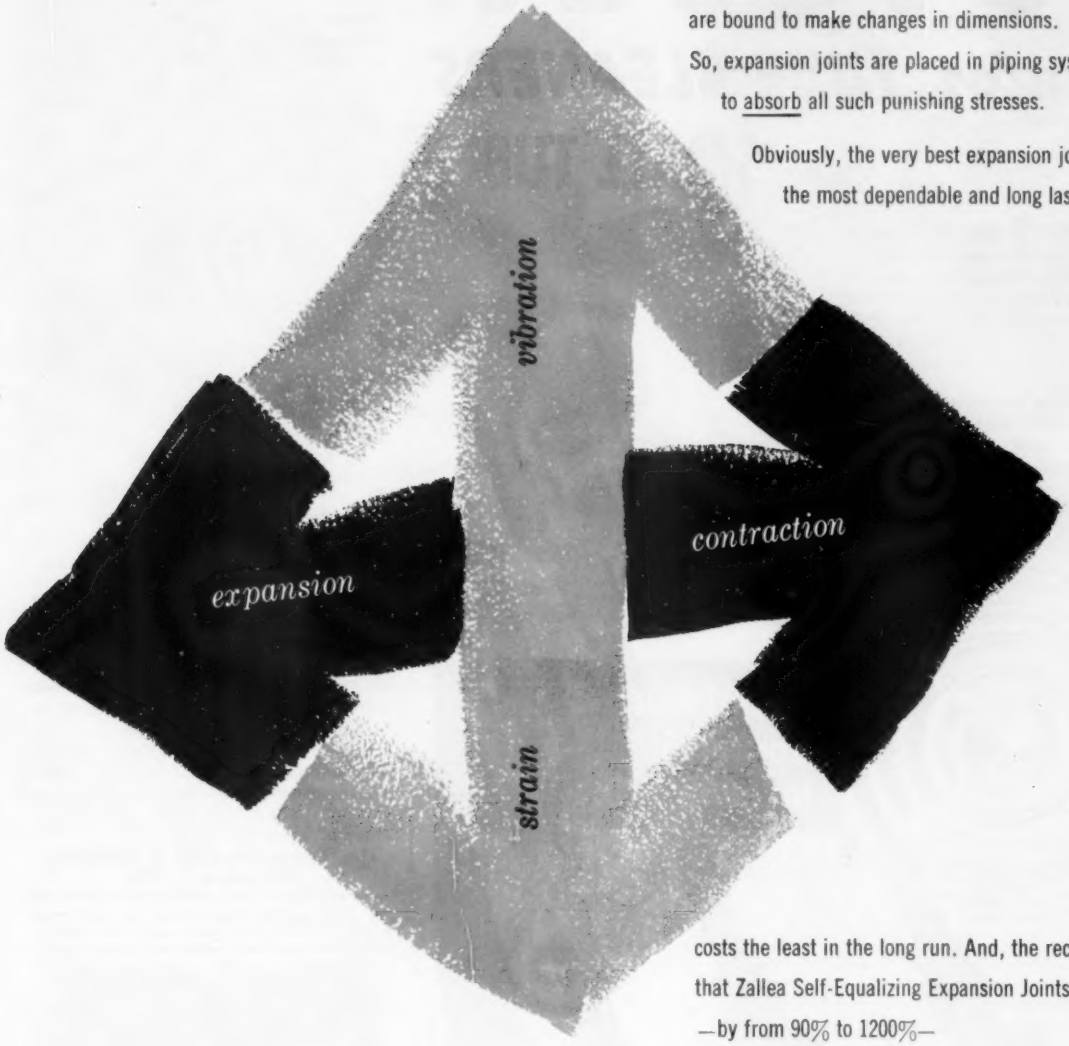
Trane Co, La Crosse, Wis.

Flexible cable clamp

956 • Loop-type cable clamps are made of laminated fiber glass cloth and polyester resins. Because fiber-glass plastic is a nonconductor, the clamps do not require insulation, thereby cutting cost, weight and space. They are suited for construction, plant maintenance, power generation, com-

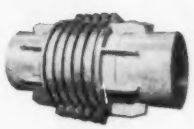
Piping in power, petroleum and processing plants
is designed to move.
After all, service variations
are bound to make changes in dimensions.
So, expansion joints are placed in piping systems . . .
to absorb all such punishing stresses.

Obviously, the very best expansion joint,
the most dependable and long lasting,



costs the least in the long run. And, the records show
that Zallea Self-Equalizing Expansion Joints outlast
—by from 90% to 1200%—
any other self-equalizing
or other type of packless joint.

Zallea already has, or will make, expansion joints for every service. For information on standard types, ask for Bulletin 351. For consultation on special problems, ask to have a representative call.



So, that's why you should insist
that the Zallea name be on
the next expansion joints you buy. To do so protects
both your piping . . . and your pocket book.

Zallea *expansion joints*

ZALLEA BROTHERS, 814 LOCUST STREET, WILMINGTON 99, DELAWARE

World's Largest Manufacturers of Expansion Joints

ROTOJET®

Junior TUBE CLEANERS for SMALL TUBES

The new Rotojet Junior Tube Cleaner has unusual power to clean small tubes quickly. This convenient, compact, self-contained cleaner, designed for one-man operation, needs very little headroom. Tube bundles can be cleaned without removal from shell.

Roto expanding heads and brushes with replaceable wearing elements save money and assure thorough cleaning of straight and curved tubes.

Send for Bulletin J-410 for full details.

S328 ROTOJET Junior Water-driven Motor, flexible coupling, and expanding scraper

C434 ROTOJET Junior Air-driven Motor, flexible coupling, expanding brush.

S32 ROTOJET Junior Air-driven Motor, cone cutter, universal joint.

ELLIOTT COMPANY-ROTO DIVISION

153 Sussex Avenue • Newark 1, N. J.

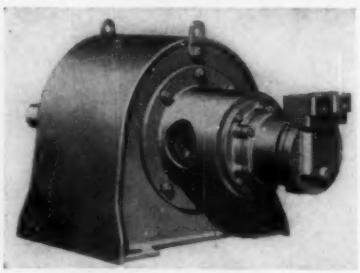
More EQUIPMENT NEWS

Begins on page 156

munications, and other industries using cable or heavy wire.

Their service life is longer than metal clamps, because flexibility gives greater fatigue resistance, even when subjected to continuous vibration. They also cause less wear on cable insulation than unprotected metal clamps do. Twenty-two sizes ranging from .125-in. diameter loop to 2-in.

Le Conte Plastics Co, Inc, Farmingdale, L. I., N. Y.



Hydraulic motor with integral speed reducer

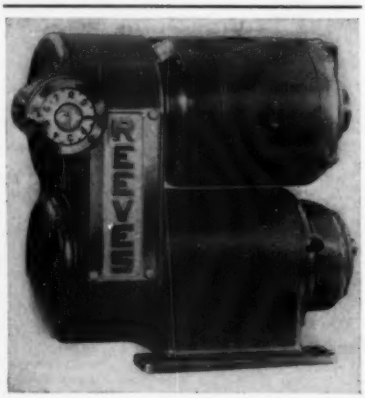
957 • *Oilgearducer* units combine *Oilgear's* new line of type H fluid power constant displacement axial piston motors with *Falk* concentric and right angle all-steel reducers, producing variable-speed drives.

The motors are connected to single, double, triple and quadruple reducers providing output speeds from 1.7 to 1170 rpm. Normal output torques range from 42 to 41,500 lb-in. based on 1100 psi.

Typical applications include stokers, pumps, compressors and fans. The units are recommended for drives requiring accuracies from 0.1 to 0.5% over a wide range of loads and speed ratios.

The Oilgear Co, 1560 W Pierce St, Milwaukee 4, Wis.

For more data on these items, use post cards p 165. Identify your request with item number.



Variable-speed drives

958 • Completely redesigned fractional hp *Varispeed Motodrives* are available in ¼ through ¾ hp sizes, speed ranges from 2:1 to 10:1, with outputs from 3 to 4600 rpm.

The units are small, compact, have 112 different assemblies to meet exact space

Ultra-Modern Design

Administration and Research Center
S. C. Johnson & Son, Inc., Racine, Wis.
Architect: Frank Lloyd Wright
Consulting Mechanical Engineers:
Samuel R. Lewis & Associates

...fired by **coal**

In the famous plant of Johnson's Wax, modern equipment makes coal a clean and automatic fuel . . . and saves dollars year after year.

Says: Adrian Wilson, Power Plant Assistant Manager
S. C. Johnson & Son, Inc.
Racine, Wisconsin

"Our plant uses an average of 900 tons of coal per month. At the conclusion of a recent analysis of relative fuel costs, we were unable to justify a change from coal to any other fuel. In burning coal the modern way, we have steadily improved the efficiency of our power plant."

•

If you plan to modernize—or to build a new plant, be sure to investigate the convenience and money-saving advantages of coal when burned with modern equipment.

You can enjoy automatic operation and save on labor by installing up-to-date coal-feeding and ash-handling systems. And you can eliminate dust or smoke nuisances with such devices as dust collectors and cinder rejectors. Often such equipment can pay for itself in fuel and labor savings in only a few short years.

Get the advice of a consulting engineer. He can make a fuel analysis for you. He can advise you on what equipment can best fill your specific needs and return you a big saving year after year with coal.

YOUR BEST BUY IS BITUMINOUS

- **Today's lowest-cost fuel,** in most places, is Bituminous Coal!
- **The most stable fuel in price is coal,** because coal reserves are virtually inexhaustible . . . coal mining is highly mechanized.
- **The safest fuel to store and use** is coal.
- **Your best bet for saving dollars is coal** . . . for modern equipment greatly multiplies coal's inherent advantages.

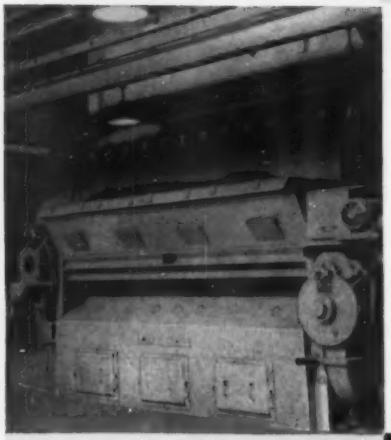
Additional case histories, showing how other types of plants have modernized and saved money by burning coal with modern equipment, are available upon request.

BITUMINOUS COAL INSTITUTE
A Department of National Coal Association
Southern Building, Washington 5, D. C.

FOR HIGH EFFICIENCY FOR LOW COST

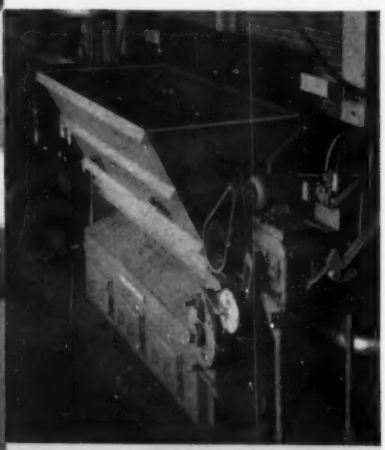
YOU CAN COUNT ON COAL!

LACLEDE CHAIN GRATE STOKERS SERVE INTERNATIONAL HARVESTER WELL



CANTON, ILLINOIS WORKS

Laclede Chain Grate Stokers at these works, as well as other works, of INTERNATIONAL HARVESTER COMPANY help in the production of their world famous products.



INDIANAPOLIS, INDIANA WORKS

MEMPHIS, TENNESSEE WORKS

LACLEDE STOKER COMPANY
4440 HUNT AVE. • ST. LOUIS 10, MO.

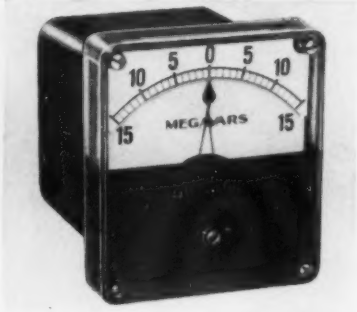
Founded in 1904

More EQUIPMENT NEWS

Begins on page 156

requirements. Threaded spiral groove lubrication system is said to assure complete lubrication of all sliding surfaces; overflow outlet carries excess lubricant away from disk faces and v-belt. Bulletin M-543.

Reeves Pulley Co, Columbus, Ind.

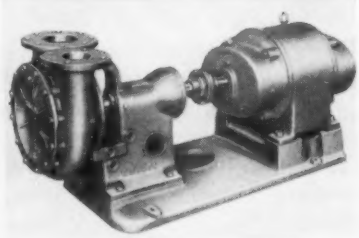


Full-view panel instruments

936 • Line of 4½-in. panel and switchboard instruments with clear plastic fronts. These *Model 610* instruments admit maximum light to dial eliminating need for internal illumination under normal conditions. Lower portion of plastic front is normally black but colors can be provided to fit any color-coding scheme. Bulletin available on request to manufacturer.

Weston Electrical Instrument Corp, 614 Frelinghuysen Ave, Newark 5, N. J.

For more data on these items, use post cards p 165. Identify your request with item number.



Centrifugal pumps

906 • Support-heed centrifugal pumps, specially designed for handling corrosive liquids and slurries, are available in several alloys and in nine sizes, providing capacities to 720 gpm, heads to 200 ft. Maximum liquid temperature for operation of pump is 350 F with provisions for water cooling of support head and quenching of gland. Additional details in bulletin 725.4.

Goulds Pumps, Inc, Dept PR, Seneca Falls, N. Y.

Packaged boiler

959 • Low-cost steam generator for small commercial applications, the *Steam-Pakette* is available from 15 to 30 hp, 125 psi. Unit can be used with No. 3 fuel oil, gas or combination firing. It is built in accordance with ASME boiler code, and stamped National Board, according to the manufacturer.

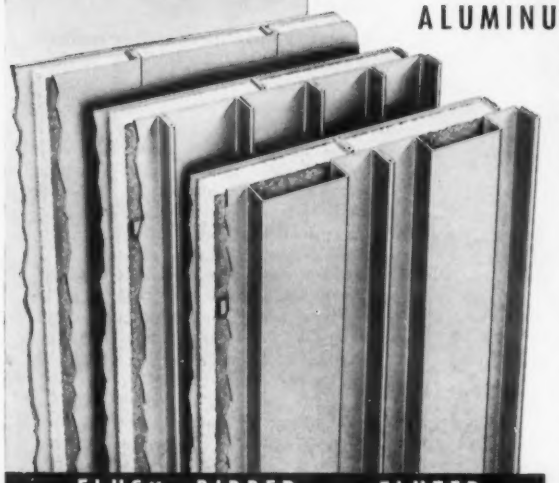
York-Shipley, Inc, York, Pa.

(*More Equipment News on page* 186)

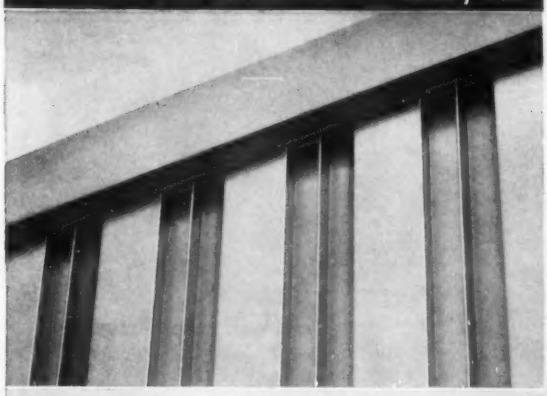
INSULATED METAL WALLS

for POWER and STEAM GENERATING PLANTS

ALUMINUM, STAINLESS or GALVANIZED STEEL



FLUSH, RIBBED, or FLUTED
Over-all "U" Factor of Various Types is Equivalent to or Better than Conventional 16" Masonry Wall

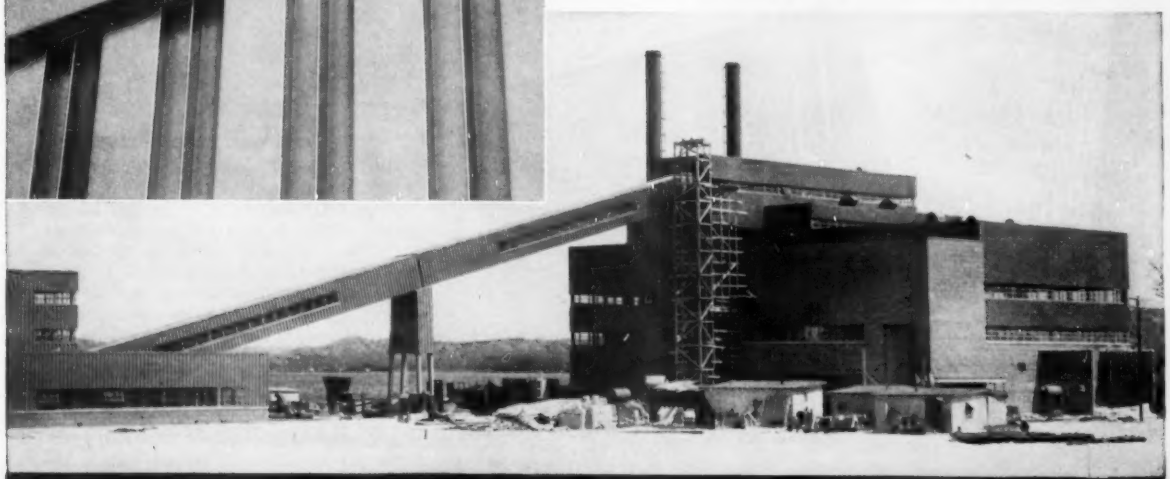


In modern powerhouse construction, the trend is to Insulated Metal Walls of Aluminum or Stainless Steel. Designers and Power Companies who have already completed one or more generating plants with metal exterior walls, are not only pleased with the over-all appearance of the structures, but are most enthusiastic about the building economies effected and the other advantages of this light weight curtain wall type of construction. In addition to an impressive number of powerhouses of various types, Mahon can today point to hundreds of complete industrial plants, schools, office buildings and other special purpose structures built with Mahon Insulated Metal Walls. In each of these projects, important building economies were realized through lower material costs, lower labor costs, and the cumulative advantages of reduced construction time resulting from rapid erection . . . buildings can be quickly enclosed with Insulated Metal Walls—even under low temperature conditions which would preclude masonry construction. Mahon Insulated Metal Walls are available in three exterior patterns. The Mahon "Field Constructed" Fluted or Ribbed Wall can be erected up to sixty feet in height without a horizontal joint—a feature of Mahon walls which is particularly desirable in powerhouses and other types of buildings where high expanses of unbroken wall surface are common. See Sweet's Files for complete information, or write for Catalog No. B-55-B.

THE R. C. MAHON COMPANY

Detroit 34, Mich. • Chicago 4, Ill. • Representatives in All Principal Cities

Manufacturers of Insulated Metal Walls and Wall Panels; Steel Deck for Roofs, Partitions and Permanent Concrete Floor Forms; Rolling Steel Doors, Grilles and Underwriters' Labeled Automatic Rolling Steel Fire Doors and Fire Shutters.



MAHON

thoughts on PREFABRICATED PIPING

BENDING

IS AN ART

Pipe properly bent can be used to great advantage when added flexibility is needed in an assembly — and gives great economic advantage in the majority of piping layouts.

The operations require skill to properly sand pack to prevent flattening; require controlled temperature to assure uniform bending; demand controlled cooling to insure the exact required dimensions.

Only in a qualified pipe fabricating plant are the necessary equipment and skilled workmanship available to insure best results.

FABRICATED PIPING DIVISION

LUMMUS

PLANT AND GENERAL SALES OFFICE AT 504 WEST 145TH ST., EAST CHICAGO, INDIANA
HEAT EXCHANGER DIVISION PLANT AT HOMESDALE, PA.
MAIN OFFICES OF THE LUMMUS COMPANY AT 385 MADISON AVE., NEW YORK 17, N. Y.

More EQUIPMENT NEWS

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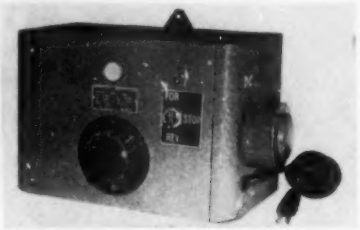


Variable voltage rectifier units

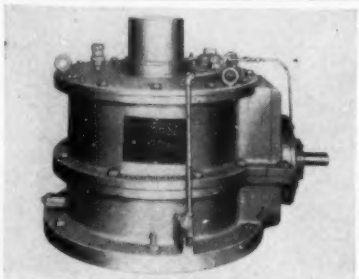
960 • Line of variable voltage rectifier units has single-phase input from ½- to 3-hp; and 3-phase input from ½- to 75-hp. These manually-operated units convert any dc motor into a variable speed motor with range from zero rpm to rated speed or above. The smaller, single-phase units can be plugged into any ac outlet and have reversing switches as part of the control. One knob controls speeds on all units.

Known as *variable voltage selenifiers*, they are available for either 50-60 cycle input at any input voltage, and dc output voltages of 115, 230, 250 or 440. Units are completely self-protected, and have pilot light indicating that the rectifier is "on."

Units are useful for any machine requiring speed variation, controlled without stopping the operation—like conveyors, printing machines, machine tools, paper slitters, etc.

American Rectifier Corp, 95 Lafayette St, New York 13, N. Y.

For more data on these items, use post cards p 165. Identify your request with item number.



Deep well pump drive

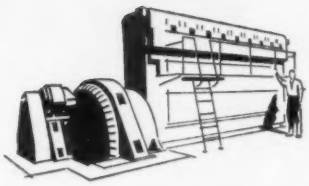
961 • Flexible deep well pump drive, *PR-12*, can obtain any ratio up to 5:1. Designed for connection of internal combustion engines to deep well pumps, drive may be used as either speed increaser or reducer. Vertical shaft is hollow to permit passage of pump shaft into split coupling hub. Split hub allows easy adjustment of pump shaft to any position. Capacity is 50 to 450 hp.

Universal Gear Corp, 1452 E 19th St, Indianapolis 7, Ind.

Automatic electric melting pots

962 • Melting pots for soft metals such as babbitts, lead, solder and type casting metal maintain close control of pouring temperatures. They are widely used in preparing metals for bearings, tinning and soldering of electrical connections.

Pots come in three sizes for solder: 150, 750, and 1500 lb. For babbitt melting: 170,



"Cured... bearing failure in their diesel-driven, front-end loaders"

A large fire-brick manufacturing company in the Philadelphia area had the problem of premature bearing failure in its diesel-driven loaders and shovel.

Headlights on even in daylight...

Sinclair Lubrication Engineer Harry Donovan reports, "These units were operating around the clock under conditions *so dusty that headlights were required.* Crankcases had to be drained and flushed bi-weekly! My first recommendation was closer adherence to an air filter maintenance program."

Drain intervals doubled!

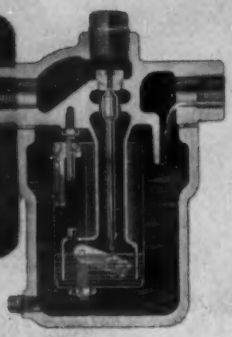
Mr. Donovan continues, "Further observation proved to me that excessive idling and overloading were all contributing factors to a severe sludge condition. I recommended Sinclair SUPER TENOL® — explaining that the superior quality of the base oil plus the Sinclair formulated additives would extend bearing life *while at the same time removing accumulated lacquer and sludge.* A trial period proved SUPER TENOL doubled drain intervals and eliminated flushing entirely. This company now uses Sinclair SUPER TENOL exclusively."

Why not give a Sinclair Lubrication Engineer the chance to solve *your* lubrication problems? *There's no obligation.* Contact your local Sinclair office or write Sinclair Refining Company, 600 Fifth Avenue, New York 20, N. Y.

SINCLAIR LUBRICANTS

Reliability

DESIGNS THAT REPRESENT 50 YEARS TRAP BUILDING EXPERIENCE



"airxpel"

STEAM TRAPS

Remove Both Air and Condensate

This equipment offers design advantages that represent long experience in building steam saving devices for industry.

Orifices of Wright-Austin traps can be interchanged without disassembling the trap. Connections are the straight-through type. Both of these features contribute to speed and ease of installation.

Wright-Austin traps are available for lines ½" to 3", for pressures up to 600 P.S.I.G. and with capacities up to 65,025 pounds of water per hour.

For complete information on traps and other accessories that you can stock to advantage and depend on for efficiency that means low cost, write, today, for:

Trap Catalog #600
Separator Catalog #500
Boiler Trim Catalog #700

"CUB" TYPE
½" to 1½"
to 250 PSIG

"MASTER" TYPE
½" to 2"
to 300 PSIG

"Y" STRAINERS
2" to 8" (flanged)
½" to 3" (threaded)

FORGED STEEL
½" to 1¼"
to 600 PSIG

WA Standard with STEAM USERS SINCE '94

WRIGHT-AUSTIN COMPANY

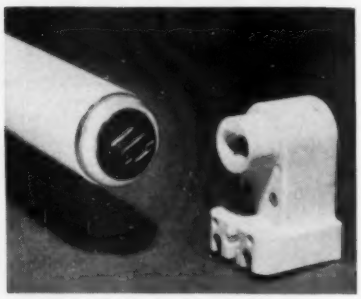
3245 WIGHT STREET • DETROIT 7, MICH.

More EQUIPMENT NEWS

Begins on page 156

860, and 1710 lb. Accurate temperature control of molten metal is provided by a thermostat bulb immersed in the metal and protected by a cast iron tube.

Westinghouse Electric Corp, P O Box 2099, Pittsburgh 30, Pa.



Fluorescent lamp ups output

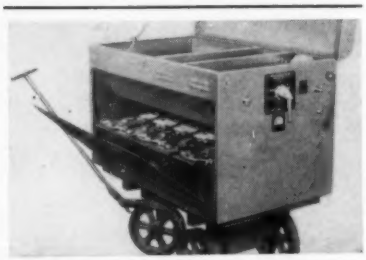
963 • First of a new line is a standard cool white lamp, 8-ft long and with a diameter of 1½-in. Rated at 110 w, it has a total light output of 6800 lumens, or almost three times that produced by the popular 40-w size. Its rated life is 7500 hours.

Base is of entirely new design. It incorporates two contacts recessed in a single element, and allows the lamp to be inserted easily and safely in push-pull type holders. Unit will be used only in new fluorescent lighting installations employing the *rapid start* circuit.

Lamp maintains high light output even in cold weather. First unit will be in the 96-in. size, and in the standard cool white color. A 72-in. size is planned for later production, as are de luxe colors for store, office and school lighting jobs.

General Electric Co, Nela Park, Cleveland, Ohio

For more data on these items, use post cards p 165. Identify your request with item number.



Battery unit for welding studs

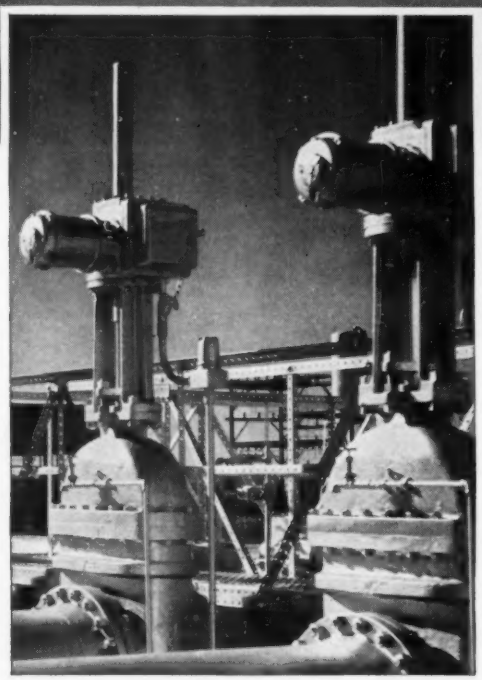
964 • Where no power is available, portable battery unit does job on welding studs up to ½-in. diameter. Tap selector switch, calibrated in weld-base diameters, regulates current. Twelve heavy-duty wet batteries of 150-ampere-hr rating are kept charged, when connected to 115-v 60-cycle single-phase a-c source, by automatic charger that test-checks open-circuit battery voltage every 10 minutes and charges when terminal voltage is below normal.

KSM Products, Inc, 322 Woodland Ave, Merchantville 8, N. J.

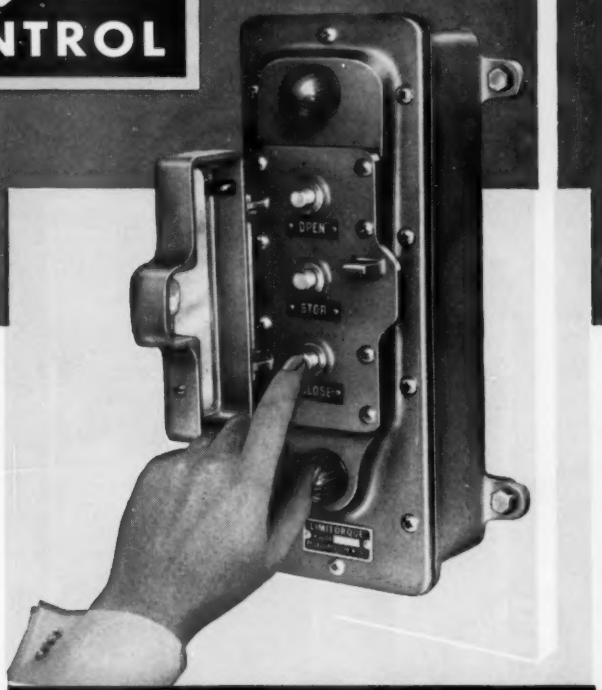
(*More Equipment News on page* 190)

AUTOMATION?
...yes, at its Best with

Limitorque®
REMOTE CONTROL



More LimiTorques are in daily use throughout the World, than all other makes combined. LimiTorque is now adaptable to Microwave Control, if desired. Write for Catalog L-54.



push button operation

Throughout Industry today, there is an ever increasing demand for Automatic Control and Operation . . . to save time, labor and money . . . to assure safety and absolute dependability. AUTOMATION is not new in valve operation, because, for over 25 years thousands of important valves have been operated by LimiTorque push-button control in Refineries, Oil and Gas Pipe Lines, Central Stations, Power Plants, Paper and Pulp Mills, Water and Sewage Plants, Chemical Plants, and on Shipboard. . . . And, LimiTorque not only opens and closes valves, but it automatically shuts-off the current, should an obstruction be encountered in closing. . . . Another feature, should there be a failure in the power lines, LimiTorque can be readily de-clutched and manually operated by the handwheel.

PHILADELPHIA GEAR WORKS, INC.

ERIE AVE. AND G ST., PHILADELPHIA 34, PA.
NEW YORK • PITTSBURGH • CHICAGO • HOUSTON • LYNCHBURG, VA.

Industrial Gears & Speed Reducers

LimiTorque Valve Controls

DUAL CONTROL means ECONOMY

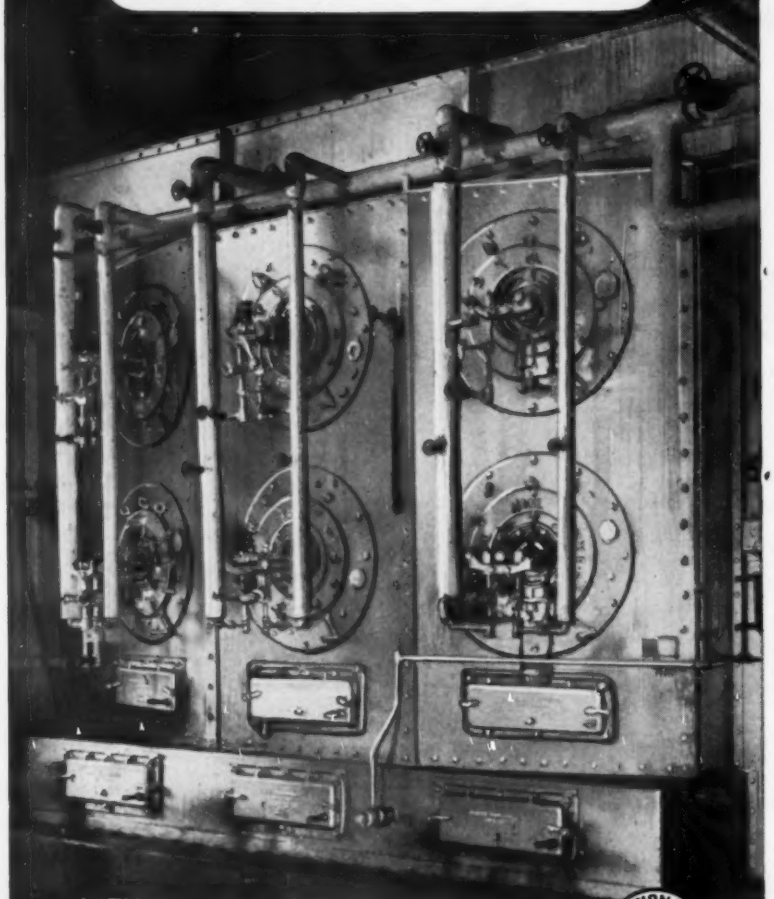
with NATIONAL AIROIL Universal Registers

AND TYPE "S-A-L" OIL BURNERS

. . . and economy means that you get better performance with NATIONAL AIROIL Universal Registers because they have a dual feature for controlling air volume independent of turbulence. Air vanes can be instantly reversed to change direction of turbulence while air volume is separately regulated by a refractory faced disk control. Both adjustments can be made while the Type "S-A-L" Oil Burner is firing.

Another "dual advantage" of NATIONAL AIROIL Universal Registers is that they are equipped for dual fuel firing of gas and oil.

Universal Registers with Type "S-A-L" Burners are available in three (3) sizes . . . capacities up to 60,000 lbs. of steam produced per burner per hour. Write for Bulletin 51.



NATIONAL AIROIL BURNER INSTALLATION
BRITISH AMERICAN OIL COMPANY

NATIONAL AIROIL BURNER CO., INC.

1250 EAST SEDGLEY AVE., PHILADELPHIA 34, PA.
Southwestern Division: 2512 South Boulevard, Houston 6, Texas
INDUSTRIAL OIL BURNERS, GAS BURNERS, FURNACE EQUIPMENT

More EQUIPMENT NEWS

Begins on page 156

Leak detector

940 • Instrument locates leaks in all types of pressure piping systems. *Dragnet* detector consists of test pump, air storage tank, pressure gauge, transparent bubble bowl, flexible hose for connecting to piping under test.

After piping is pumped with air to desired pressure, by-pass valve is closed, requiring any air entering pipe from storage tank to flow through the bubble bowl. Any leak in piping brings air from the storage tank through the dip tube in bubble bowl, causing liquid to bubble and indicating the leak.

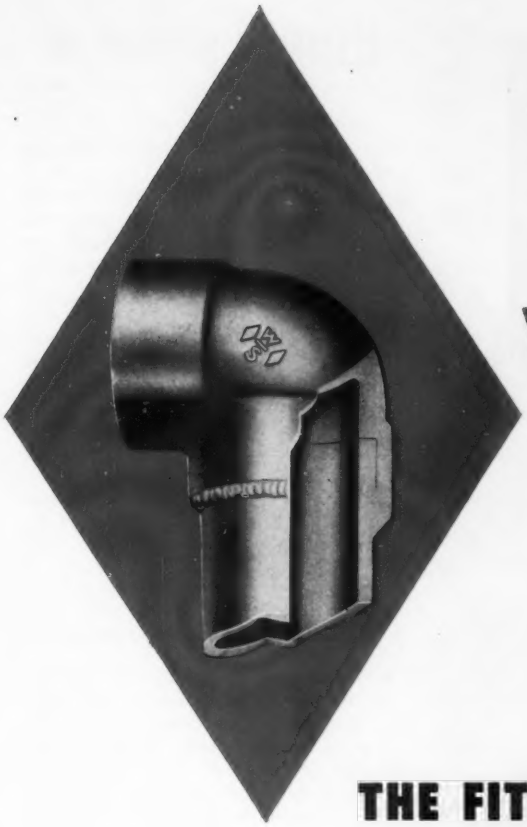
Universal Controls Corp, 731 W Davis St, Dallas, Tex.

For more data on these items, use post cards p 165. Identify your request with item number.

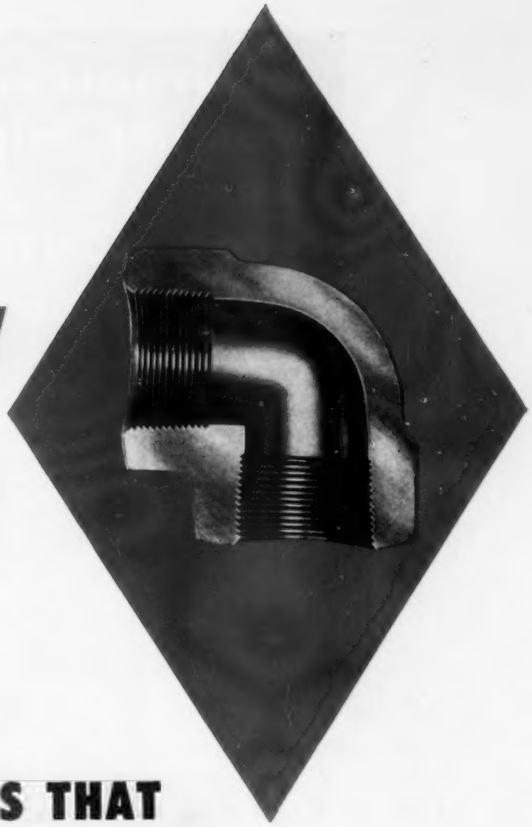
Industrial unit heaters

911 • Completely redesigned unit heaters for steam or hot water operation are built in wide range of sizes for any industrial or commercial application. Both horizontal and vertical types are available. Units are tested and rated in accordance with Standard Test Codes adopted jointly by Industrial Unit Heater Assn and American Society of Heating and Ventilating Engineers. Request bulletin 7517.

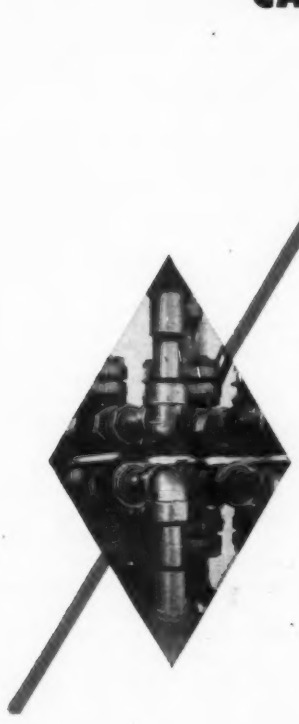
American Blower Corp, Tireman Ave at Roselawn, Detroit 32, Mich.



W-S



THE FITTINGS THAT CAN REALLY TAKE IT!



Every elbow, tee and cross in a high pressure piping system is a point of concentrated stress. W-S Forged Steel Fittings take this tough service in stride because they're fabricated and designed to resist pressure, heat, shock and vibration. They're drop forged of highest quality steel to produce a dense, tough, forged-fiber structure that can really take it. And careful heat treatment after forging develops the metallurgical properties of the steel to their fullest.

Notice, too, how Watson-Stillman engineers have designed extra strength into the fittings. Long bands extend well beyond the threads or sockets to provide extra reinforcement. Wall thickness is carefully calculated to put extra metal at points of severest stress.

W-S high-precision machining and rigorous inspection follow through to give you the fittings that mean stronger, tougher pipe joints. W-S Forged Steel Fittings are available in both Screw-End and Socket-Welding types in carbon, stainless and alloy steels.

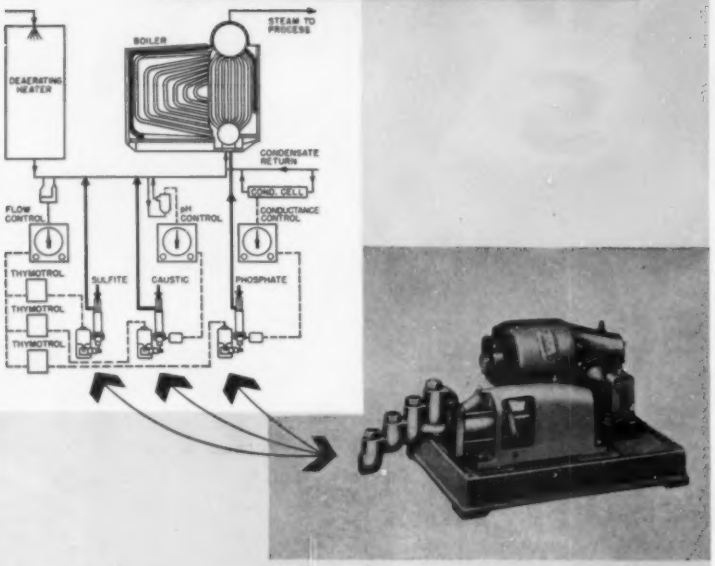
Sold Through Leading Distributors

WATSON-STILLMAN FITTINGS DIVISION

H. K. PORTER COMPANY, INC.

Roselle, New Jersey

CONTROLLED VOLUME PUMPS ARE FLOW-CONTROL INSTRUMENTS



Here's how they solve another water treating problem

In the system illustrated, three Milton Roy Controlled Volume Pumps *automatically* control the proportional feed of treating chemicals to boiler feed water: sodium sulphite for oxygen removal . . . di-sodium phosphate for calcium precipitation and scale prevention . . . caustic for pH control. Results? Decreased turbine and boiler downtime . . . optimum boiler water conditions!

Thousands of such Milton Roy complete water treating systems and Controlled Volume Pumps installed throughout industry save time and money for large and small power plants alike. Standard "packaged" systems are furnished complete, for pumping controlled volumes of chemical additives against any boiler pressure.

Write for Technical Paper No. 55—"Automatic pH Control in Water Treatment."

Engineering Representatives in the United States, Canada, Mexico, Europe, Asia, South America and Africa

MILTON Roy COMPANY

Manufacturing Engineers 1305 E. MERMAID LANE • PHILA. 18, PA.

CONTROLLED VOLUME PUMPS AND AUTOMATIC CHEMICAL FEED SYSTEMS

ELECTRICAL DISTRIBUTION

Continued from page 85

modify this plan to use all possible existing system components with particular attention to switchgear.

Next, be sure the new power system meets its requirements as to minimum voltage regulation, cost, distribution losses, reliability, simplicity of operation, minimum of maintenance and proper utilization voltage level. Just which of the above methods or tools is the one to apply in your system is basically a problem of economics in keeping with good engineering. If industrial-plant load is to increase 25% in the United States in the next seven years, it is estimated that 50% of today's industrial plants will face a major expansion in that period.

MARMADUKE

Continued from page 144

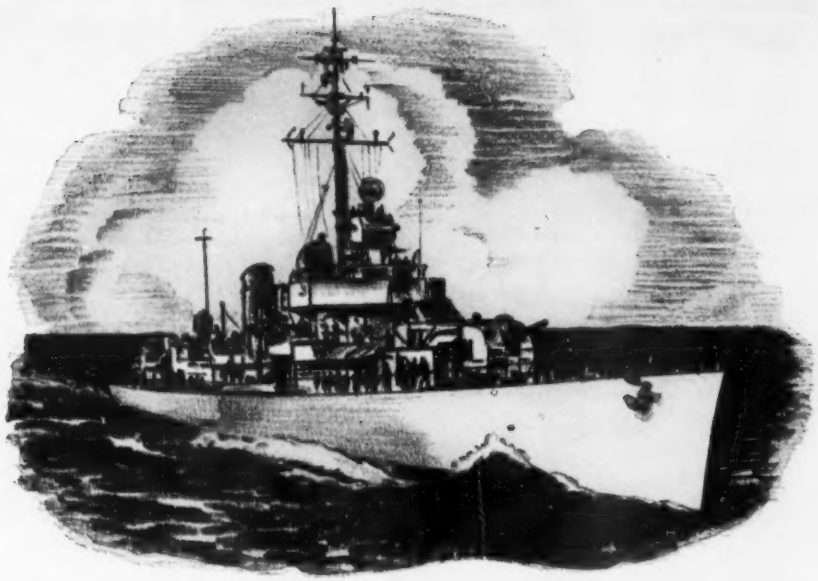
"I saw that mess next morning, but at the time no one seemed to know how it happened. A few months later, Slicebar had more trouble. This time the barge had hooked up the large 6-in. hose to his filling line and Slicebar's second assistant had handed down the flexible steam hose for running the barge's big duplex fuel-oil pump.

"But when the second assistant opened the steam valve on his ship for the barge's pump, the pump made only a few strokes, then stopped. When the barge captain saw the oil pressure go up to 75 psi and his pump stop, he yelled aboard, asking if the filling line's valve in the ship's fireroom was open.

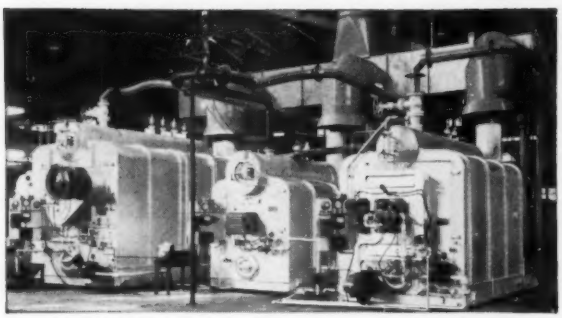
"The second assistant checked the valves on his filling line, settling tanks and double bottoms. They all were open. But just as he ran up on deck to check with the barge captain again, the 6-in. fuel-oil hose parted. With 75-psi oil pressure and a lively breeze, the newly painted ship's superstructure, decks, dock, barge and everything else for a few hundred feet around was showered with bunker-C oil before the pump was stopped.

"I had to hire 25 laborers. They used up 28 sacks of sawdust, 100 gallons of kerosene and 3 bales of rags to clean up that awful mess. Some of our newest manila hawsers on deck were oil soaked and had to be given the deep six.

"While the cleaning was going on, the second and his boys opened the fuel-oil valve-manifold in the fireroom to see why that oil didn't get into the tanks. They found two burlap sacks wedged so tightly into the valve openings that they had to use a chainfall to pull them out. A long time later I learned that Snifty had the burlap poked inside the



"the Shakedown Cruise"



Each KEYSTONE Steam Generator is FACTORY FIRE TESTED with the fuel and burner to be used

Before the United States Navy considers a ship as ready to take her place with the fleet, she is given a **shakedown** cruise. This cruise allows the Navy to check the ship from stem to stern and to make sure each working part is functioning properly. Exhaustive tests such as these assure the Navy that its ships can meet any emergency.

In our modern plant each Keystone Steam Generator is given a **shakedown** before it is consigned to your boiler room. The complete electrical circuit is checked to insure proper operation of all controls and the unit is then FACTORY FIRE TESTED with the specified fuel at the desired load conditions. Thus Erie City assures you of trouble free operation with your Keystone Steam Generator.

Erie City gives you a true package . . . boiler, burner, controls, draft equipment, all mounted, piped, wired . . . and FACTORY FIRE TESTED. Only basic field service connections are required to place your Keystone Steam Generator in operation. Every desirable advantage of modern power generation has been incorporated into the Keystone Steam Generator. Bulletin SB-51 gives a full description of the Keystone's many features.

You can depend on Erie City for sound engineering

ERIE CITY
114 Years in Steam Generation

ERIE CITY IRON WORKS • *Erie, Pa.*

STEAM GENERATORS • SUPERHEATERS • ECONOMIZERS • AIR PREHEATERS
UNDERFEED AND SPREADER STOKERS • PULVERIZERS

THERE'S MORE FOR YOUR MONEY··IN

PANALARM "50" ANNUNCIATOR SYSTEMS

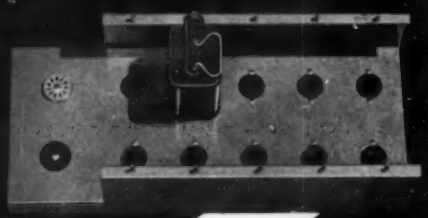
No annunciator system ever offered as much in value as PANALARM "50".

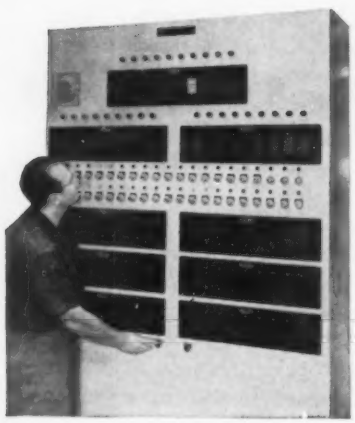
Examine for yourself every piece and component . . . consider the savings you realize through standardization and complete flexibility that only PANALARM "50" provides.

Then, evaluate *dependability*. Beyond all else, PANALARM "50" represents the greatest value in audio-visual alarm systems by its record of *dependable service* alone.

STANDARD CHASSIS

is interchangeable without re-wiring for all types of annunciator service: standard audio-visual; ringback; bullseyes or name-plates; trouble or running signals; lock-outs; or low drain operation.





PANALARM IS PROVEN!

In hundreds of plants—serving for many years—Panalarm Annunciators have demonstrated outstanding performance. They have won confidence for the very critical part they play in plant operation and safety.

PANALARM PLUG-IN UNITS

. . . *heart of the system* . . . incorporate finest telephone-type relays and special contact arrangements . . . assure sequential operation. Hermetically sealed suitable for Class I, Div. 2 locations.

SEND FOR COMPLETE MANUAL.
Ask for Catalog 100-A

PANALARM PRODUCTS, INC.
7417 N. HAMLIN AVE., SKOKIE, ILL.

PANALARM®

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MARMADUKE

Continued from page 192

large filling hose while it was still on the oil barge. Then after the hose was connected from the barge to the filling line, the oil carried the burlap down into the manifold. Slicebar was ready to tear whoever did that trick from bow to stern—but he could only guess who did it.

"Three voyages later Snifty's ship tied up at our home pier on her way up to Boston, while Slicebar's ship came in to be loaded for her trip down South.

"Because the pier already had two ships tied up on either side, the *Tuscaloosa* had to be tied up to the *Savannah*, which is common practice. That should have worked out OK because the *Savannah* was being unloaded onto the dock while the *Tuscaloosa* would fuel and then pull into Snifty's place after she had gone.

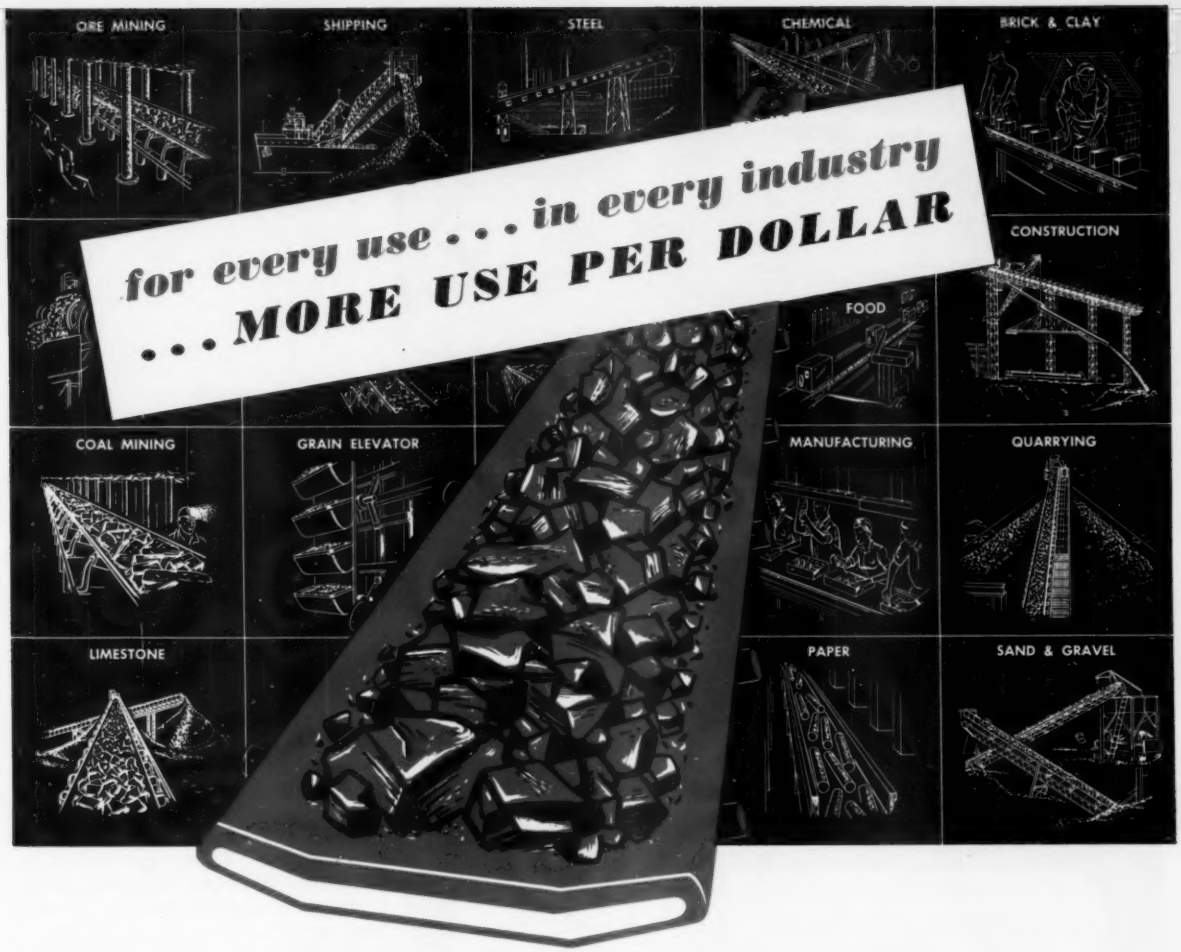
"It just happened that the starboard side filling line on Slicebar's ship was at the same height and aimed right at Snifty's porthole, like a large cannon. Knowing the bad blood between those two and having heard scattered rumors of what Snifty had been up to, I checked the filling line cover plates on the *Tuscaloosa* to make sure they were tight. Snifty was on deck and I asked him to come up to my office on the dock. I didn't like the way he figured his coal consumption that trip and had a few questions to ask him. I already had enough information about his sneaky ways to hang him, but I'd do that next trip after I had all the facts.

"I don't know what happened while Snifty was in my office, but I can guess. When he got back aboard his ship and opened his cabin door, he had a surprise he'll never forget. His room was full of fuel oil right up to the door coaming and more was flowing in through the port hole. Evidently someone had removed the filling-line cover-plate after I had checked it.

"That oil was one hell of a mess to clean up, and Snifty got such a good dose of his own medicine that he signed off right there, leaving most of his oil-soaked gear aboard. In a way I wasn't sorry because he deserved it, but still it was a costly trick."

With that, Marmy suddenly stopped talking and turned back to the bar to take on bunkers for his own double bottoms. Then just as suddenly, he slapped down his bottle and roared, "And that's when I formulated one of my laws, known since as Surfaceblow's Second Law of Fuel-Oil Filling Lines."

On hearing this startling information, Marmy roared, before any of us could say anything, "Here it is. When you pump fuel oil through a filling line that has an opening between the two

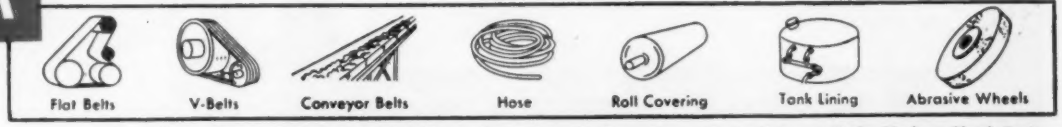


R/M CONVEYOR BELTS

If conveyor belts are your problem, turn to Raybestos-Manhattan. There are R/M Conveyor Belts with extra cushion for heavy shock loading. R/M Conveyor Belts for mining, quarrying, or bulk materials are unequalled for natural troughing, flexibility and long life. The latest exclusive development of R/M engineers is the "XDC" cover which protects heavy duty conveyor belts against wear, abrasion, cuts and tears to a degree never before attained. Hot material, high tension, long lift, oil or non-spark conditions . . . all are met with special R/M Conveyor Belt designs. Equally good engineering goes into R/M Belts for light duty . . . packages, parts, cases or wood chips. For every use R/M Conveyor Belts give you More Use per Dollar. Consult an R/M representative. Ask him also about R/M Hose, Transmission, V-Belts and other industrial rubber products.

MANHATTAN RUBBER DIVISION—PASSAIC, NEW JERSEY

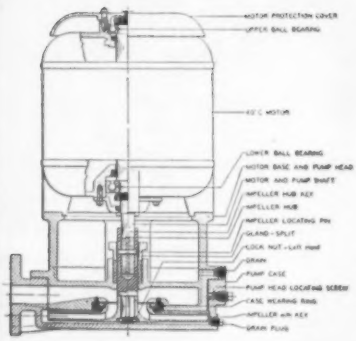
RAYBESTOS-MANHATTAN, INC.



Other R/M products include: Industrial Rubber • Fan Belts • Radiator Hose • Brake Linings • Brake Blocks • Clutch Facings Asbestos Textiles • Packings • Engineered Plastic, and Sintered Metal Products • Bowling Balls RM-417

HOFFMAN "WATCHMAN" CONDENSATION PUMP

TYPE "WC-8-20" Specifications
RATING: Up to 8000 Sq. ft. E.D.R.
PUMP CAPACITY: 12 Gals. per min.
PRESSURE: 20 lbs. per square inch at pump discharge
RECEIVER CAPACITY: 9 Gallons
MOTOR: ⅓ H.P., 3450 R.P.M. Single Phase, 60 cycle, 115 or 230 volts
SHIPPING WGT.: 180 pounds
FOR HIGH EFFICIENCY
24"
FITS MINIMUM FLOOR SPACE
LOW OVER-ALL HEIGHT
16½"
MOTOR HIGH ABOVE WATER & DIRT
9
LOW INLET



This compact, highly efficient Condensation Pump is ideal as a replacement for old Boiler Return Trap installations. Immediate delivery can be made from stock. Ask your Wholesaler for full particulars with prices, or write for new Hoffman Condensation Pump Catalog CP-454, no obligation.

Here is a vertical, close coupled pump for low pressure heating systems, featuring:

1. One piece cast bronze centrifugal impeller dynamically balanced for smooth running and long life.
2. Receiver of heavy rust resistant cast iron.
3. All operating parts including motor and impeller assembly can be inspected or replaced without disturbing inlet or discharge piping.
4. Two pole heavy duty float switch easily adjusted.

HOFFMAN SPECIALTY MFG. CORP. 1001 York St., Indianapolis 7, Ind.

Makers of Valves, Traps, Hot Water Heating Systems, Vacuum and Condensation Pumps . . . Sold by Leading Wholesalers of Heating and Plumbing Equipment

MARMADUKE

Continued from page 194

ends, you'll have an oil spill every time if you build up pressure inside the line unless you close the opening before the oil spills out."

Marmy stopped talking again, this time long enough to let that amazing law soak in. Then one of the bookish-looking characters who had been soaking up bottled inspiration himself, suddenly brightened up and remarked, in a highly authoritative manner. "That, gentlemen, is undoubtedly the greatest piece of pure logic ever heard or seen by man or beast, and I've heard and seen plenty."

Before we could recover from this new development in an already unusual story, a crusty looking mariner, sporting a black eye and a skeptical look on his weather-beaten face, piped up and yelled, "Ahoy there, Mr Surfaceblow, if that's your second law on fuel-oil filling lines, what in hell's your first?"

"The first!" roared Marmy, at the top of his lungs, getting pink around the gills. "I thought every jackass knew my first law, but since some dumb jerks don't, here it is: The greater the distance from the fuel barge to the filling connection aboard ship, the longer the filling hose, provided the hose is long enough to reach from one to the other."

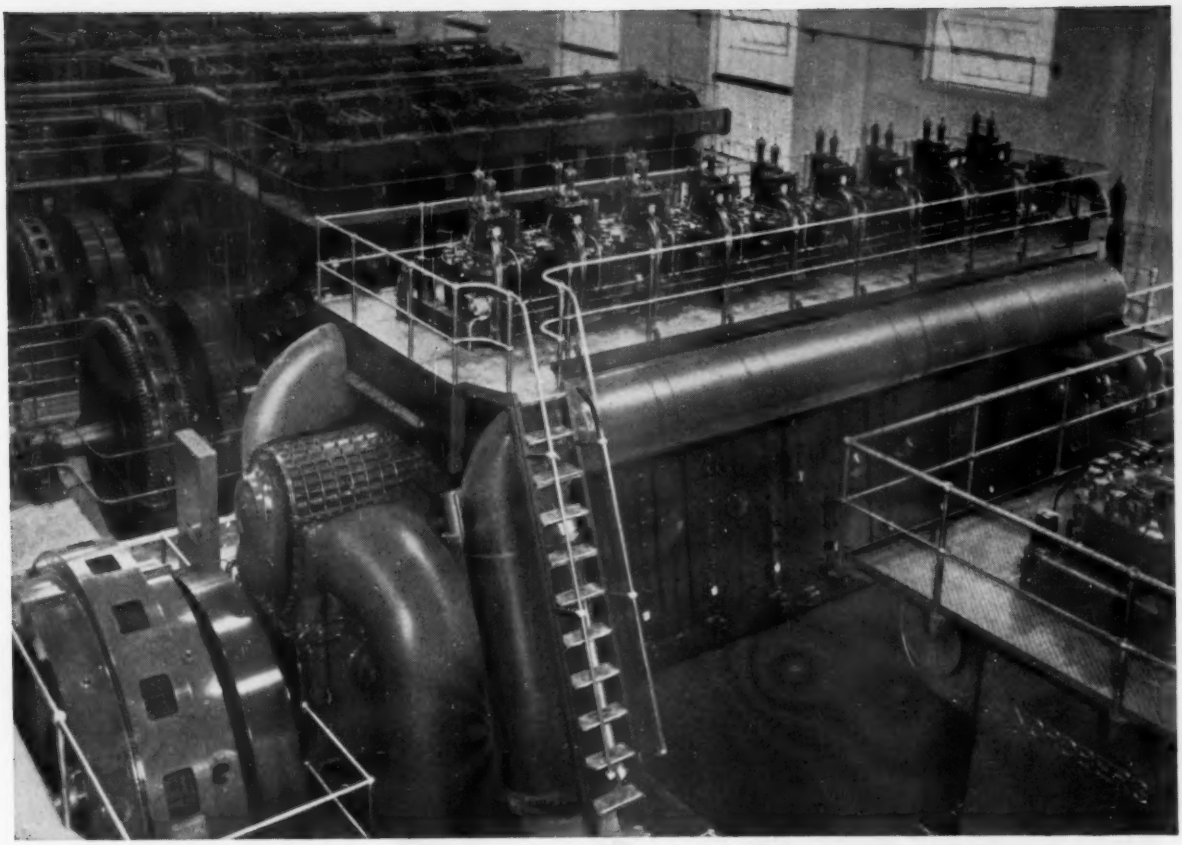
With that, Marmy straightened up, drained his bottle of Sandpaper Gin and walked out of the bar. I stared at my beer, trying to find a flaw in Marmy's two unbelievably simple "laws." But the more I thought about them, the dizzier I became—so I turned bottoms up and shoved off for my office before the boss dropped me from the payroll.—*SME*

BLOWDOWN

Continued from page 118

installing this takeoff, care must be taken that there is no likelihood of short circuiting between feedwater, chemical feed and continuous blowdown.

In the firetube package design, water travels in the two crescent-shaped ovals, one on either side of the furnace cylinder. Incoming feedwater goes down alongside the cooler boiler shell, then turns inward and upward around the hot combustion chamber, finally over, and back downward to the feedwater inlet. The correct position for this boiler's continuous blowdown takeoff is just above the furnace cylinder, so as to include the crests of both water circuits. These units are usually provided with a surface-blowoff connection in the center or last third of the boiler, through



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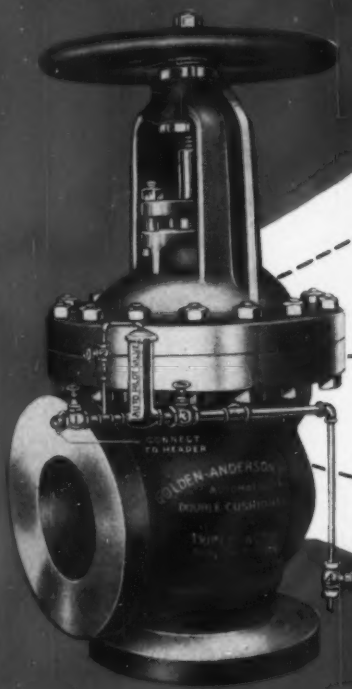

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BLOWDOWN

Continued from page 196

which the takeoff can be extended.

In a straight-watertube longitudinal-drum boiler, feedwater enters toward the back of the drum, flows down the rear water leg, passes through the generating tubes, then travels up the front water leg and back along the drum. Here the takeoff should be placed within the front quarter of the drum.

With the 3-drum bent-tube design, feedwater makes its entry in the top rear drum, flows down the back circulating tubes, passes through the mud drum, rises in the generating tubes, then travels through the upper-front drum and on back into the top-rear drum. The continuous blowdown takeoff for this type unit should be located in the upper-rear drum, just off the outlets of the equalizer tubes between the two upper drums.

For the multiple-drum Stirling-type boiler, proper position of the take-off is determined individually, according to the particular design. The steam-generating section is regarded as separate from that of the economizer, although the latter is an integral part of the unit. Only those drums that form links in a closed, recycling pattern can be considered. For instance, in a 4-drum boiler the continuous blowdown may be taken off the top-rear drum or the upper-center one, depending on whether the top-back drum is included with or excluded from the main water circuit.

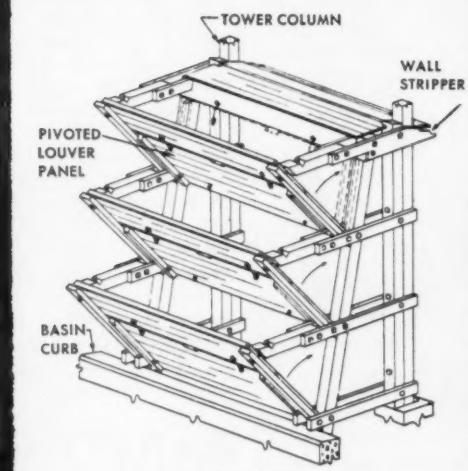
In a 2-drum design, feedwater enters the top drum, flows down the rear bank of tubes, passes through the mud drum and rises back to the upper drum via the waterwalls and front circulating tubes. The continuous blowdown takeoff is to be placed just over the riser outlets, extending a third of the length of the top drum at the end receiving the greatest heat.

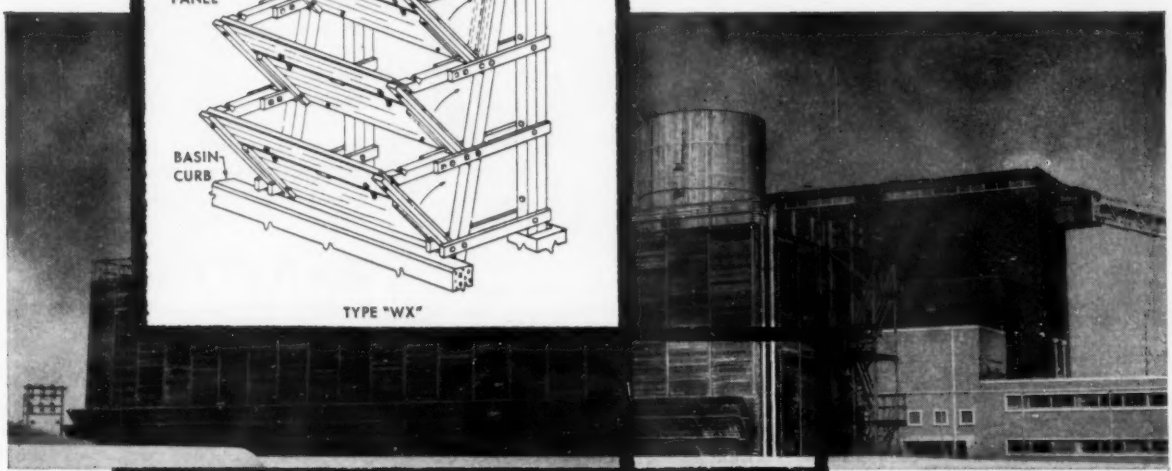
With the one-and-half 2-drum design, feedwater makes entry toward the rear of the top drum, passes down the back tubes, goes from the mud drum to the waterwall headers, rises to the upper drum and recycles via the front drum-connecting tubes. Here the takeoff should be located across the top drum, just past the last waterwall outlet.

The one-drum package unit has two separate but like paths of water circulation. Both originate in the drum, but travel on either side of the boiler The takeoff is placed in the last quarter of the drum, since the rear bank of tubes furnishes the greatest amount of steam.

Continuous blowdown piping. For best results, the takeoff should extend along or across only that section of the drum into which boiler water of highest concentration is discharging. Chemical feed entry must be located in

NO ICE NEXT WINTER





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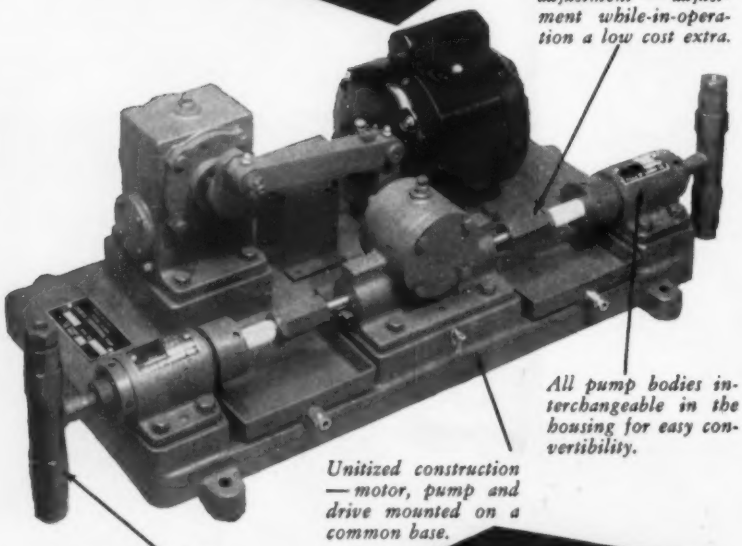
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BLOWDOWN

Continued from page 198

the opposite, cooler portion of the drum, just over the downcomer inlets.

The collector pipe is to be capped and have perforations that are equally spaced. To prevent clogging, several large slots are better than many smaller holes. Such openings are best facing downwards. The blowdown line outside the drum should be smaller than that inside (to compensate for cooling effect). But the line should not be smaller than ¾ inch inside the drum and ½ inch outside the drum. If calculations indicate smaller size is required, a continuous blowdown system is not advisable.

Gate valves should be used for shut-off. One of these is inserted just outside the individual boilers and the others in their common manifold, as needed. A flow-control valve serves to regulate the continuous blowdown rate of each boiler at floor level. Such a valve may be of the needle or V-port type. To avoid having sludge accumulate over its disk, this valve has the pressure directed beneath its seat.

More PLANT PROBLEMS

Begins on page 132

Be sure to calk and weld flanged joints to prevent corrosion from outside moisture. Steam jets in small stacks are another source of corrosion.

ART BELTON *Montreal, Canada*

LIFE EXPECTANCY of a ¼-inch steel stack varies from 10 to 15 years. Painting stack interior is not too satisfactory a solution. Lining it with magnesia blocks is far better.

A A HUNNEWINKEL *Woodstock, Ill.*

AN ECONOMIC STUDY gives the best answer to *CW's* question. He should compare the alternatives on the basis of annual cost, using a suitable interest rate for his conditions. My experience shows that no matter how careful we are with metal stacks, there is always some corrosion at the end of the normal heating season. Idle stacks corrode faster than those in operation, particularly during the summer.

Corrosion can be reduced by using a protective metal—zinc, lead, copper, nickel or tin—or by applying a protective paint. *CW* may also use an oxide, phosphate or similar coating on steel.

JOHN DOYLE *Bronx, N. Y.*

OTHER READERS sent good answers to this question. Sorry we didn't have enough space for letters from:

J H CATES *Corpus Christi, Tex.*
C G HOWARTER *Canton, Ill.*

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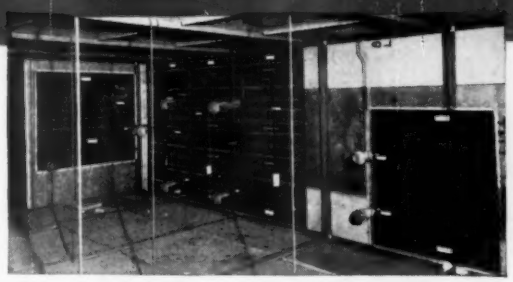


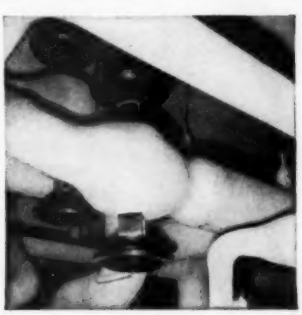
Addition to The Cincinnati Gas & Electric Company, Cincinnati, Ohio. The Union Central Life Insurance Company, owner. The Cincinnati Gas & Electric Company, lessee. Harry Hake & Harry Hake, Jr., architects; James E. Allan, mechanical engineer; Frank Messer & Sons, Inc., general contractor; Peck-Hannaford & Briggs, heating, ventilating and air conditioning contractors, all of Cincinnati.

Inside this duct Johnson Damper Operators and Dampers insure precision control of the minimum and maximum outdoor air supply for Weathermaster units throughout the building.

Perfect indoor climate gives workers a big lift in the new Cincinnati Gas & Electric Company addition. Regardless of the outdoor temperatures, employees here enjoy healthful, refreshing climate-controlled weather that keeps worker efficiency and morale at peak levels.

Like the older adjoining building, this new air conditioned addition is equipped with a modern "Planned-for-the-Purpose" Johnson System of Automatic Temperature Control. On this, and *every other installation*, Johnson Control is tailored to the exact needs of the building and its occupants. Each Johnson System is planned, made and installed by Johnson to insure the desired results at the lowest possible operating cost.

Johnson engineers, working with heating and ventilating engineers, architects, owners and builders, have helped to plan control systems for the nation's outstanding office buildings, schools, hospitals, industrial plants, department stores and public buildings from coast to coast. Let a Johnson engineer from a nearby branch office solve your next temperature control problem. A talk involves no obligation. JOHNSON SERVICE COMPANY, Milwaukee 2, Wisconsin. Direct Branch Offices in Principal Cities.



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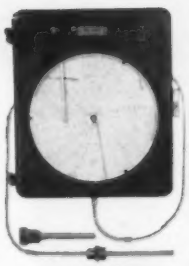

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More TECHNICAL BRIEFS

Begins on page 152

pated with present-day turbine practice.

Discussion is confined to performance of units of 100-mw capability or greater to coincide with the trend in unit ratings for central-station application. Performance data are supplemented by a brief review of turbine-design considerations.

In the region of saturated steam, some method of moisture reduction is required. Various schemes are reviewed and a comparison made to establish relative merits of the moisture separator and steam reheater. Relative effects of the principal cycle parameters are illustrated, making possible the evaluation of the saturated-steam cycle. *ASME paper No. 54-SA-65.*

Gas turbines

Operating experiences with gas-turbine plants in the steel industry—Comparison of the gas turbine with other prime movers. *By Hans Pfenninger, Brown-Boveri & Co, Ltd.*

The gas turbine has already proved itself in practice. Many plants are operating in America and Europe. Brown-Boveri has placed 14 gas-turbine sets in industrial operation, over and above those for petroleum refineries and Velox boilers. Paper describes several installations and details two sets at work in the steel industry.

In Europe a set with a 10,000-kw terminal output costs about $90 per kw. Unit has a combined burner for blast-furnace gas and oil firing. Price includes steel foundations but not the building itself. Over-all thermal efficiency is 27%, corresponding to heat consumption of 12,700 Btu per kwhr.

Plant uses only 21,000 gph of cooling water. Exhaust gases can generate about 32,000 lb per hr of steam at 85 psig. Including steam production in the overall thermal efficiency raises it to 36.5%.

Maintenance costs run 0.025c per kwhr, or about 5% of fuel costs. One operator per shift is sufficient. Set can also be built to absorb considerable shock loads, such as occur with a rolling mill.

Experience with these units has been so satisfactory, the gas turbine can no longer be overlooked in power installations for iron and steel works. *ASME paper No. 54-SA-21.*

Gas turbines for the steel industry. *By George H Krapf, United States Steel Corp.*

In a steel plant the blast furnace is a large producer of a usable fuel of low calorific value. Between 100,000 and

Directions for ordering papers on p 212

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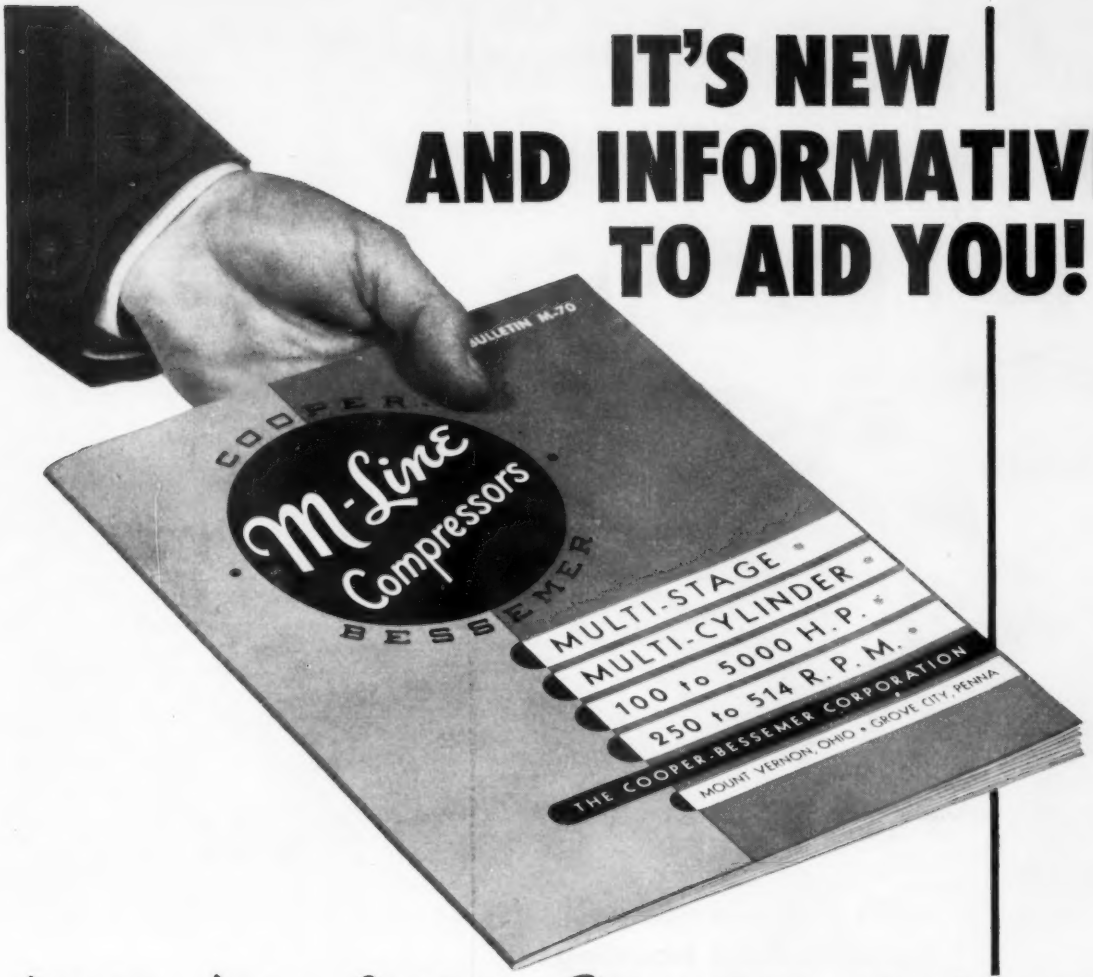

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More TECHNICAL BRIEFS

Begins on page 152

150,000 cubic feet of gas, with a heat content of about 90 Btu per cubic foot, is produced for every ton of iron made.

From 20 to 35% of this gas is used to preheat air for blowing the furnaces, and in losses, leaving 80 to 65%, or from six to nine million Btu per ton of iron available for other purposes. In fact, the availability of energy in waste gases from steel-making and heating operations in fully integrated steel plants is one of the principal reasons for the existence of their large power plants.

Early in this century large installations of gas engines were made in many steel mills to utilize blast-furnace gas for power generation and to drive furnace blowers. Many of these installations exist today, operating at thermal efficiencies so high they are met only by our best steam plants.

These installations have three serious drawbacks—high maintenance, large crews and excessive space requirements. For these reasons the trend has been to steam plants, the last gas engines being installed about 1930. Steam plants are reliable, operate at lower cost, require less area for a given output, and have a much higher availability.

We now face a new era, that of the gas turbine, with its promise of still lower operating costs, lower area requirements, operating simplicity, minimum water requirements, and possibly, lower investment cost.

It is estimated that man hours in a given gas-turbine plant should be less than half that for a steam plant with its related water-treatment facilities and other auxiliaries. Area requirements show the same promise. In addition, blast-furnace gas should be an excellent fuel for gas turbines because its flame temperature is low and its combustion products are of high density. The steel industry is therefore keenly interested in the development of this new prime mover. *APC paper; no number.*

Gas turbine process using added steam. *By Benjamin Miller, Consulting Engineer.*

Lower cost per hp for equipment and lower fuel consumption per hphr generated can be attained by adding steam to air in the gas-turbine process. To obtain maximum advantages from steam addition requires equipment not yet commercially available. But substantial increases in both capability and thermal efficiency can be achieved by adding steam-generating equipment to gas-turbine power plants being marketed, as well as to some installed units. Water

Directions for ordering papers on p 212

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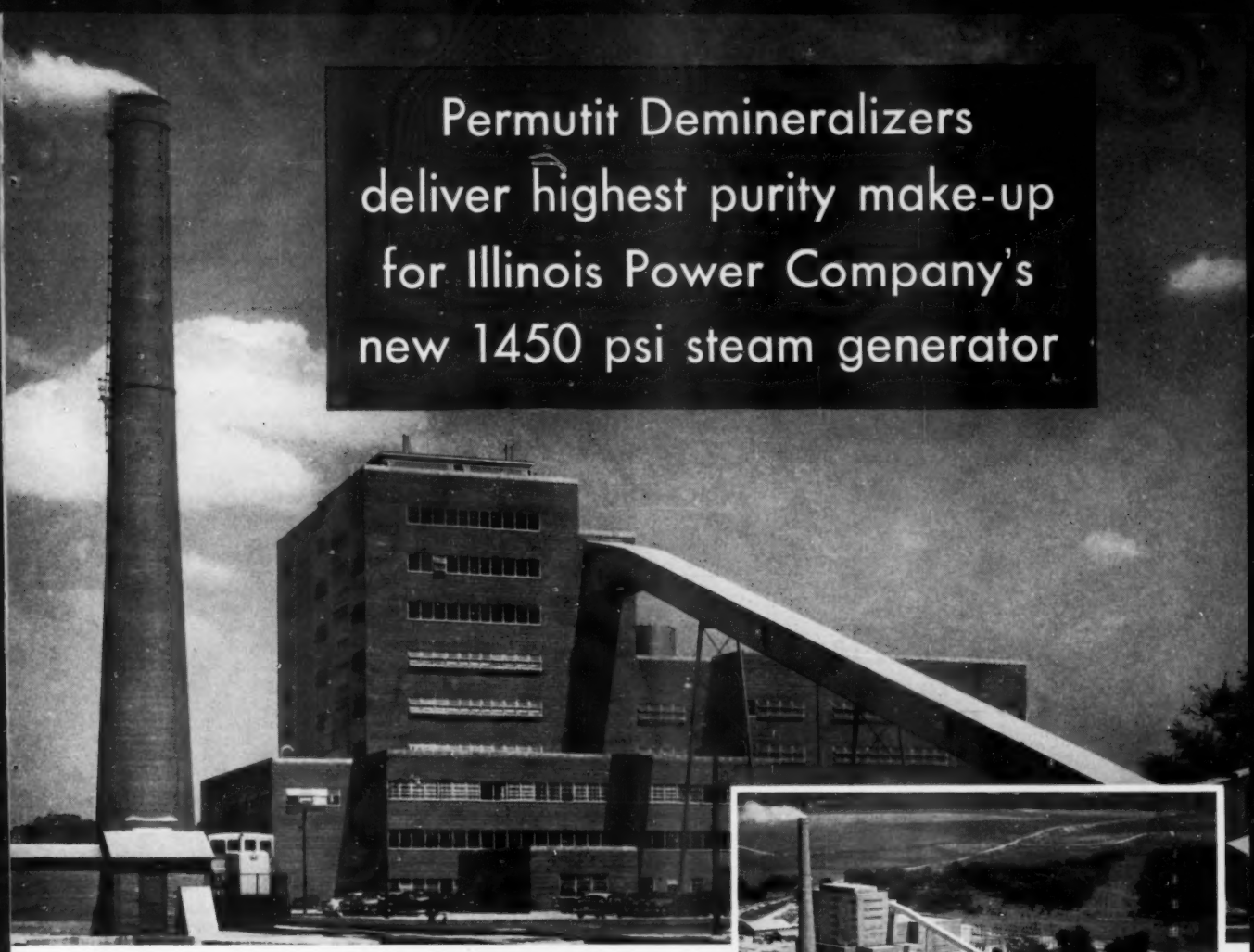

Hennepin Power Station, Illinois Power Company. Steam Capacity 525,000 lb/hr. Consulting Engineers: Sargent & Lundy

This plant's 75,000 KW turbo-generator must operate continuously at high efficiency.

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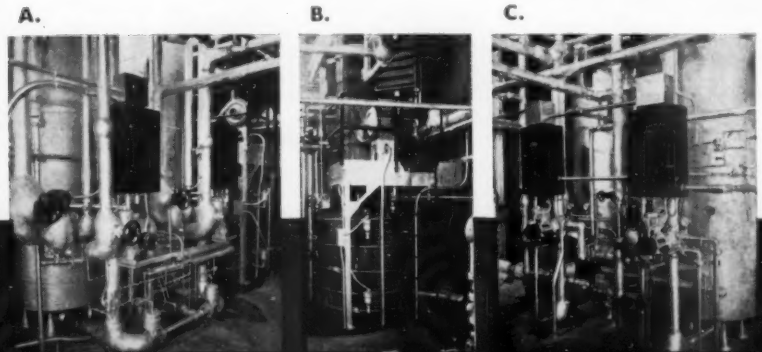

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More TECHNICAL BRIEFS

Begins on page 152

needed to generate steam must be available at reasonable cost.

For example, a gas-turbine plant rated at 5700 hp at 25% thermal efficiency can have its output increased to 7500 hp at 29% thermal efficiency by addition of steam-generating equipment costing much less than one-fifth the gas-turbine plant. Less than 50 gpm of water is needed. *ASME paper No 54-SA-42.*

Exhaust-gas sampling of a small-scale combustor and determination of combustion efficiency. *By L M Whitney, Shell Development Co.*

Need for a rapid continuous recording instrument for determining combustion efficiency of gas turbines led to development of an exhaust-gas analysis instrument based on infrared absorption. Use of this instrument in developing reliable techniques and equipment for sampling are reviewed in the paper.

By correlation with detailed mass spectrometric analysis of exhaust of a small-scale combustion tube, an accurate method of determining combustion efficiency by exhaust-gas analysis was developed. By many comparative analyses between instrument and mass spectrometer, a simplified method of obtaining rapid continuous recording of combustion efficiency of a small-scale combustor was possible. Mathematical basis for this is briefly described. *ASME paper No. 54-SA-61.*

Measurement of total emissivities of gas-turbine combustor materials. *By S Mario De Corso, Westinghouse Research Laboratories, and Roland L Colt, Westinghouse Electric Corp.*

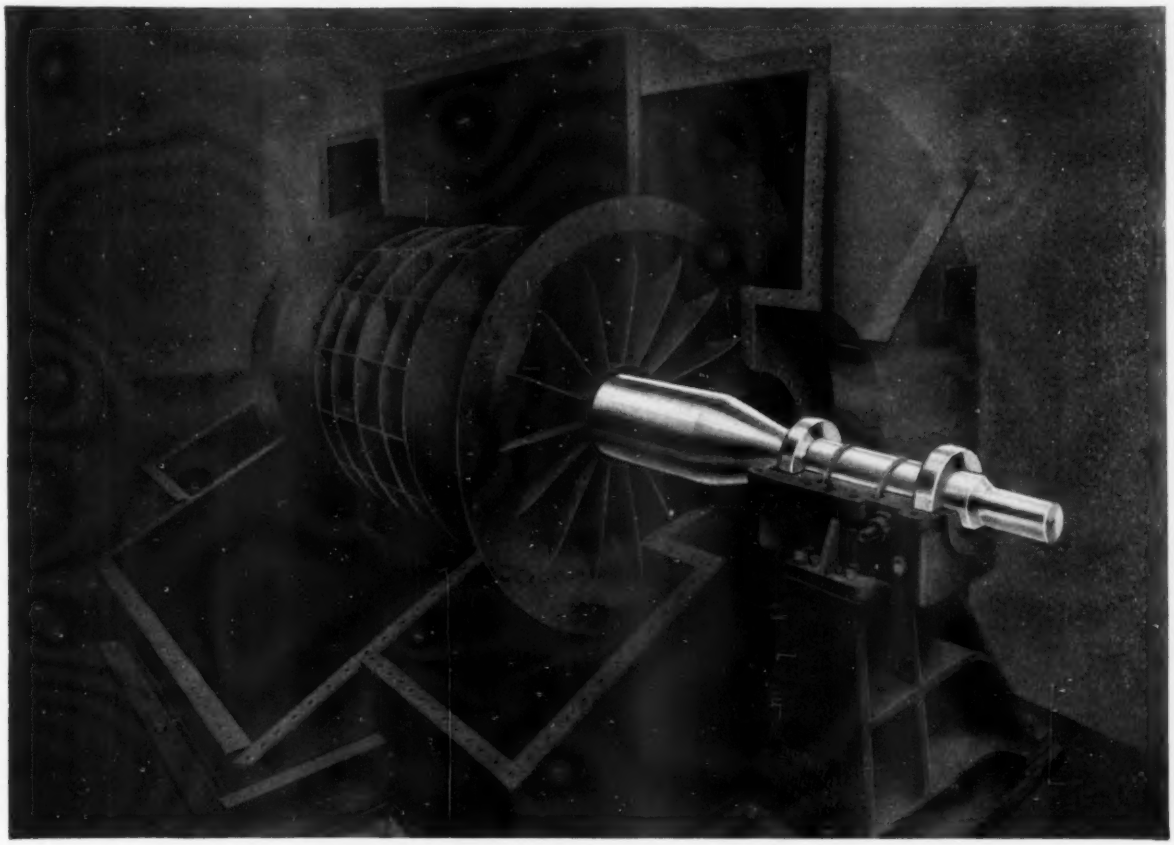
Paper presents means of measuring total emissivities of various gas-turbine combustor materials and gives data obtained for some of these materials. More thorough knowledge of this field permits selective use and treatment of materials to take full advantage of emissive properties to reduce combustor-wall temperatures. Overheating of combustor walls causing hot spots is a primary cause of combustor failure.

Emissivities of both inner and outer surfaces of a combustor wall affect wall temperature. Combustion tests by one of the authors showed radiant heat transfer from the flame is quite important. A change from diesel to residual fuel raised combustor wall temperatures from 250 to 500 F.

To evaluate different flame-tube materials and coatings it is convenient to measure their thermal emissivities under controlled conditions independent of those existing during actual operation

Directions for ordering papers on p 212

How a FAN SHAFT Turns Out CHEAPER POWER



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More TECHNICAL BRIEFS

Begins on page 152

or combustion testing. *ASME paper No. 54-SA-26*

Problems in formulation of design procedures for continuous-flow combustion of hydrocarbons. *By Gilbert S Bahn and G Warren Koffer, Marquardt Aircraft Co.*

Many combustion investigations being made today are directed at fundamental concepts and approaches. They are not intended to give quick and easy assistance to development workers.

Paper considers what is involved in establishing design procedures for combustion of hydrocarbon fuels in continuous-flow processes. It specifically considers gas turbines, turbojets, afterburners and ramjets.

Emphasis is upon problems, rather than current efforts at solution. Aspects of various problems are discussed. *ASME paper No. 54-SA-22.*

A new power cycle combines gas turbines with steam turbines. *By Louis S Gee, West Texas Utilities Company.*

In the constant search for methods of generating kilowatts more economically, the spotlight has been focused on new plants with higher pressures and temperatures. Few engineers have made sufficiently detailed studies of older plants to realize that economies can be achieved by application of a relatively new tool—the combustion gas turbine.

In the West Texas Utilities Company, a recent application of a gas turbine to the cycle of an old steam plant promises an efficiency increase of 15.15% with a resulting increase in over-all plant economy of 32%, and the addition of 6611-kw generating capacity at an installed cost of only $76.37 per kw. The paper contains a detailed description of the cycle chosen. *APC paper; no number.*

Steam turbines

Design trends in present-day steam turbines. *By C D Wilson and E P Hansen, Allis-Chalmers Manufacturing Co.*

A large number of factors are involved in steam-turbine development. Those of greatest importance to utilities are related to the economics of power generation. Large yearly increases in the use of power are making it necessary for utilities to add generating capacity in large blocks. So we find more emphasis on large units.

These involve large buildings and foundations, which are costly. So weight and reduction of dimensions are of paramount importance.

Large units are lower in cost per kilowatt of capacity and can justify

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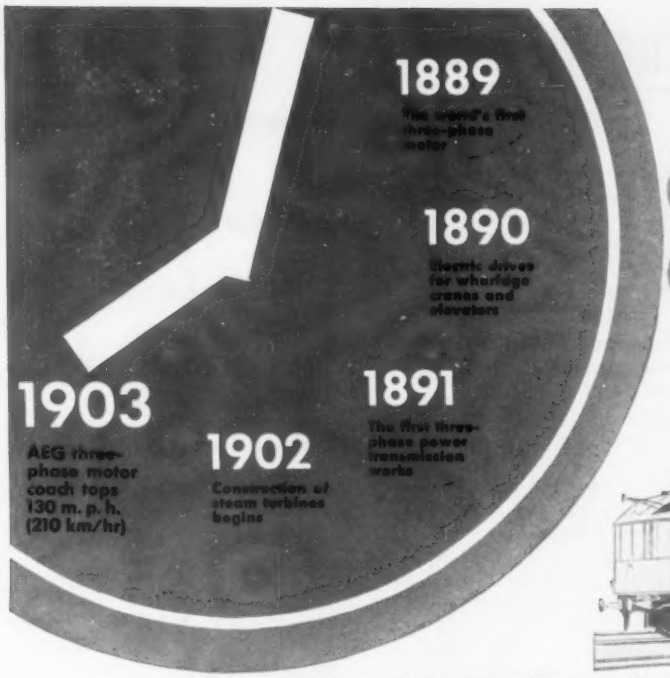

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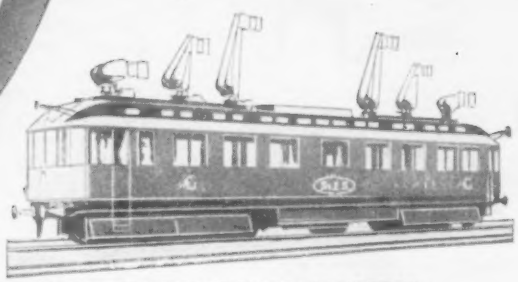

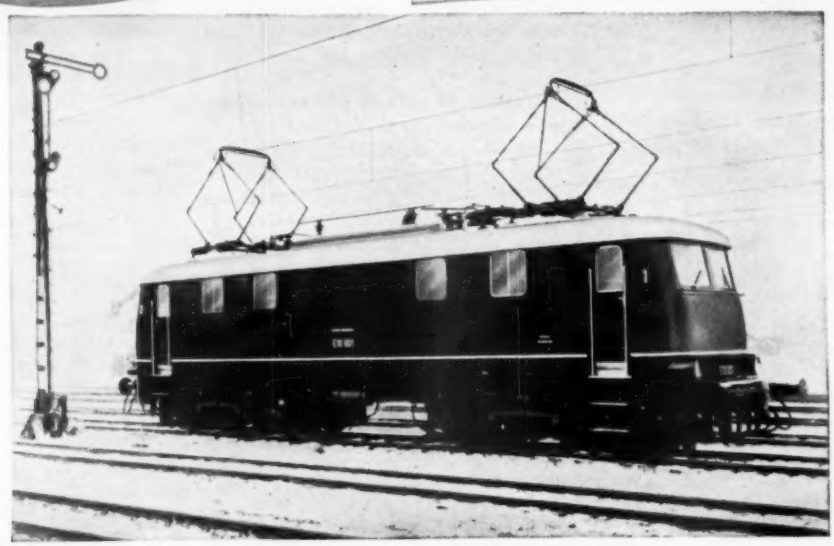

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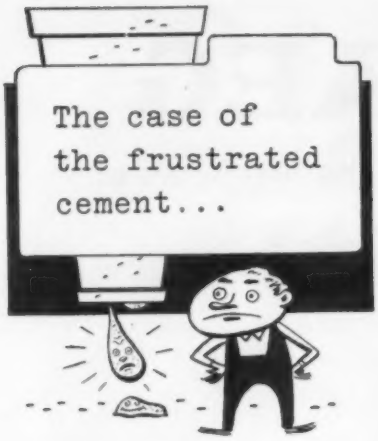

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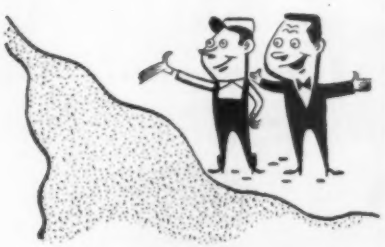

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Begins on page 152

special added features like higher inlet pressures and temperatures, reheating and optimum-size exhausts. Turbine builders are making a concerted effort to supply the most efficient equipment possible at no sacrifice in reliability. *APC paper; no number.*

Gas fuels

Physical-chemical properties of methane-ethane mixtures. *By O T Bloomer, D C Gami and J D Parent.*

Basic data required for engineering design of plants to separate ethane, a major raw material for petrochemical production, from natural gas by low-temperature fractionation are presented in this research bulletin.

Data given include liquid-vapor phase equilibria, gas-phase pressure-volume-temperature relationship and saturated liquid and vapor density values for the methane-ethane system as determined by a detailed experimental investigation with specific mixtures of methane and ethane. *IGT Research Bulletin No. 22.*

Viscosities of natural gas components and mixtures. *By N L Carr.*

Results of experimental determination of the absolute viscosity of methane and three natural-gas mixtures at pressures up to 10,000 psi and temperatures from 70 to 250 F are presented in this study.

The data, which are important in many calculations involving fluid flow, particularly in flow of gas into or out of underground reservoirs, and in pipeline transmission, are presented as viscosity-pressure isotherms showing effects of temperature, pressure and composition on viscosity. They are correlated in the form of reduced viscosity and viscosity-ratio charts. *IGT Research Bulletin No. 23.*

Hydro development

Maximizing income from waterwheel generators. *By K R Knights, Hydro Electric Power Commission of Ontario, and V W Ruskin, Canadian-Brazilian Service Ltd.*

Here is a method of determining the level of generator output and temperature that produces the maximum net income from existing plant investment. The economic limits of output and temperature, as determined, are shown in an example to be considerably higher than usual North American operating practice.

These economic limits are established by finding that level of generator output

Directions for ordering papers on p 212

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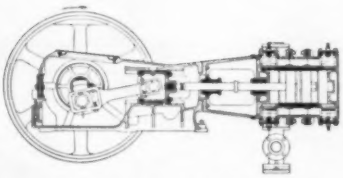

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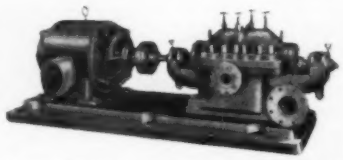

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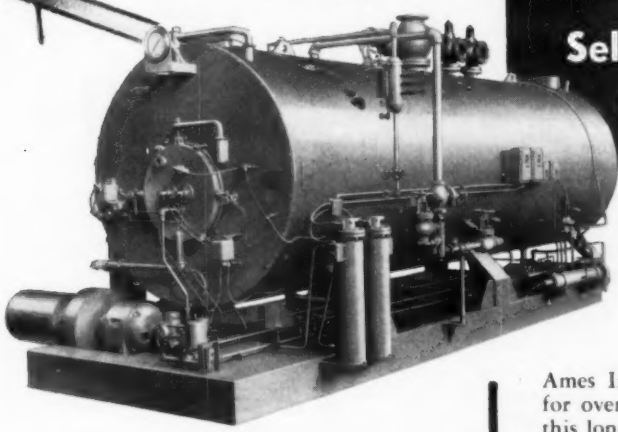

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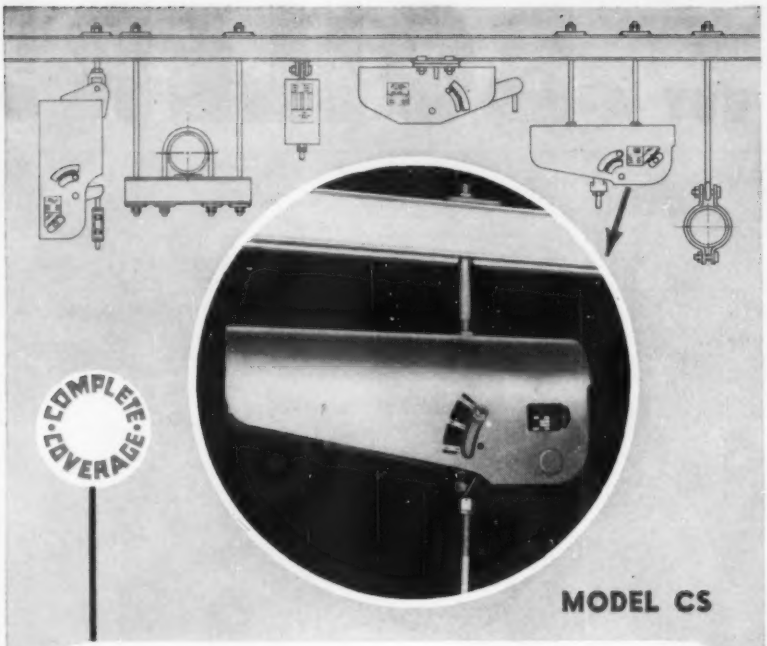

MODEL CS

This is article number 2 in a series dealing with the subject of pipe supports in modern power and industrial plants.

The constant support is a mechanical device generally used to support high temperature piping and equipment. It maintains a constant supporting force on piping under all load and travel conditions caused by thermal expansion. Its use prevents the introduction of additional stress throughout the piping system.

The basic principle behind all Bergen Constant Supports is that a varying spring force acting at an inversely varying moment arm yields a constant supporting moment. Some tolerance must be permitted due to friction and slight variation in spring scale; however, the vast majority of Bergen Constant Supports will, under exacting shop test, introduce a load variation of less than 1% throughout the entire travel range.

Space limitations are often critical in piping design. This model CS is particularly adaptable for limited head-room as the short dimension is in the vertical plane. In a following article of this series, the vertical constant support will be discussed with special emphasis on "tight" applications.

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More TECHNICAL BRIEFS

Begins on page 152

at which the maximum difference exists between annual operating revenue and annual operating expenses. Revenues and expenses are based mainly on operating and accounting records. In a sense, therefore, determining the economic limits can be considered as rating a generator by actual system performance.

The paper indicates that, provided there are no other factors limiting output, loading generators up to the economic limit may result in very substantial gains in dollars and kilowatthours. It is, therefore, believed that a review of existing loading practices for specific generating stations may be warranted. *AIEE paper No. 54-300.*

TO OBTAIN COMPLETE TEXT

Material for these abstracts comes from the following sources unless otherwise stated. Order complete paper from sources, not POWER.

American Society of Mechanical Engineers, semi-annual meeting, Pittsburgh, Pa., June 20-24. Identified by initials ASME and obtainable through ASME, 29 W 39th St, New York 18, New York.

American Power Conference, annual meeting, Sherman Hotel, Chicago, Ill., Mar. 24-26, 1954. Identified by initials APC. Obtainable in proceedings that may be purchased from R A Budenholzer, chairman, Illinois Institute of Technology, 3300 Federal St, Chicago 16, Illinois.

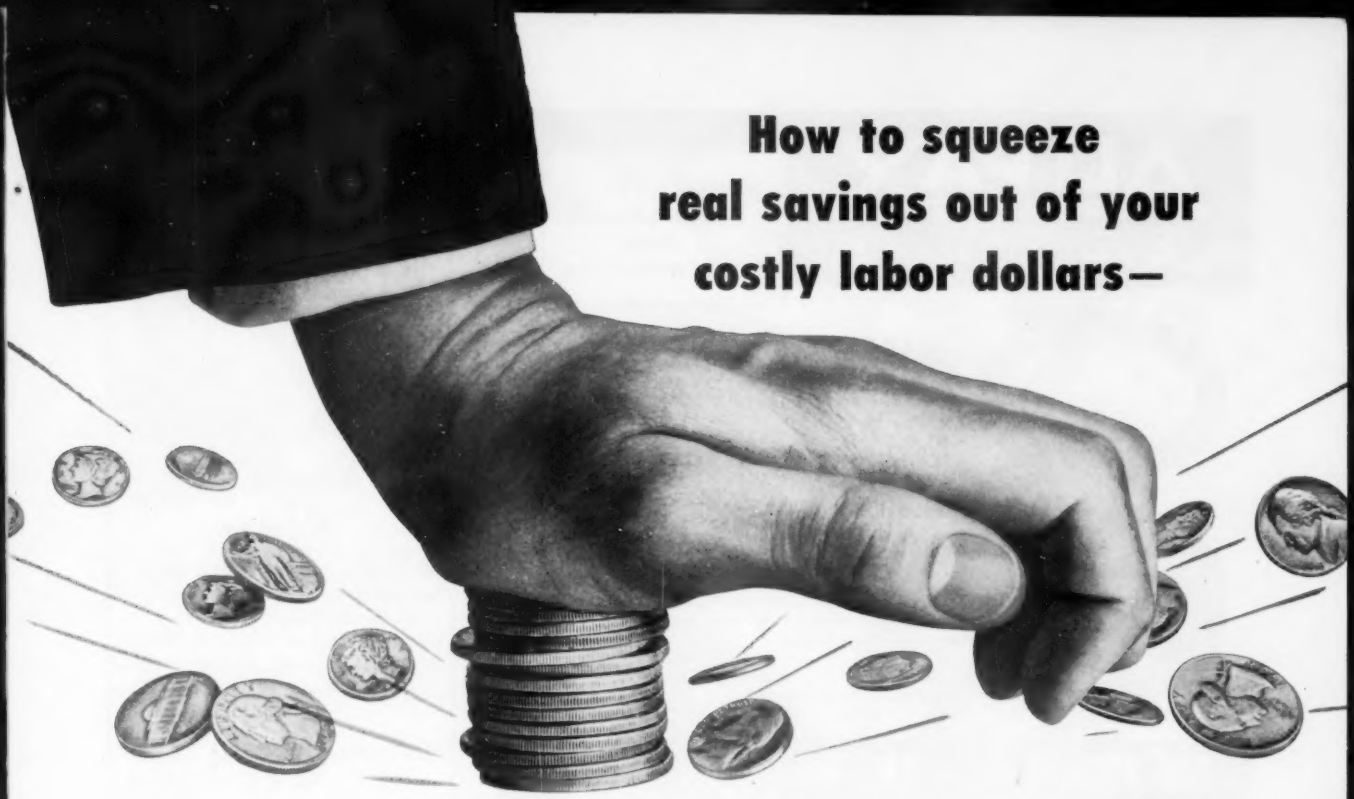
American Institute of Electrical Engineers. Identified by initials AIEE and obtainable through AIEE, 33 W 39th St, New York 18, New York.

Institute of Gas Technology. Identified by initials IGT and obtainable through IGT, 17 W 34th St, Technology Center, Chicago 16, Illinois.

New "champion" chimney in Ontario is the 615-ft reinforced concrete giant being constructed at the iron ore plant of the International Nickel Co of Canada in Copper Cliff. The great height of the chimney is to ensure proper diffusion of waste gases in the upper atmosphere.

Atomic Energy Commission named Stanford Research Institute one of three national Industrial Information Depositories of unclassified information concerning developments in the atomic energy field. Other depositories are to be maintained by the Atomic Industrial Forum of New York and the John Crerar Library of Chicago.

How to squeeze real savings out of your costly labor dollars—



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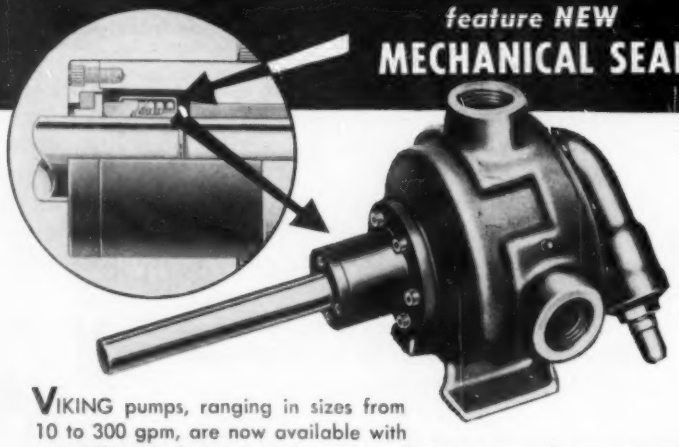

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We were in such a hurry we couldn't stop to drain the oil from the tank. And sending a man into the oil was out of the question. Luckily I found an old horseshoe magnet in the shop. We tied it to a long length of wire, and by hit-and miss fishing, lifted the spanner out of the tank. Then we finished our check.

Those tense moments while fishing for that spanner taught me a few lessons. Don't work with loose tools when there's any danger of them dropping and causing injury or trouble in locating them. Lash 'em down.

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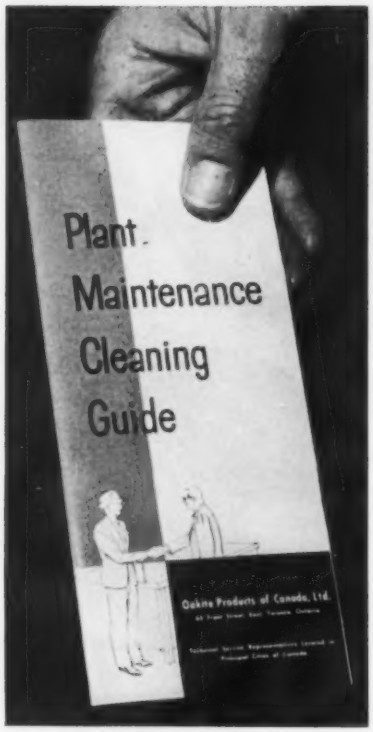

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Begins on page 165

18 **Outlets, switches** and utility boxes; 170 different types described in 40-page booklet 18-74. Construction Materials Div, General Electric Co, Bridgeport 2, Conn.

19 **Electric motors.** Twelve separate bulletins; 8 describing three-phase induction, hollow or solid shaft motors. One each on adjustable speed induction motors, geared motors, electrical controls, and haulage device. Belgian Electric Sales Corp, 1 E 53rd St, New York, N. Y.

20 **Electrification system.** Descriptions of track, trolleys and accessories used in electrification of hoists, production and assembly lines, moving test lines, etc. Illustrated 34-page bulletin 45, Feedrail Corp, 125 Barclay St, New York 7, N. Y.

21 **Two-pole motors,** 900 hp and larger. Photos, diagrams, cutaways in 8-page bulletin 05R8123. Allis-Chalmers Manufacturing Co, 952 S 70th St, Milwaukee, Wis.

HEAT EXCHANGERS

22 **Forced draft burners** for oil, gas combination firing. Packaged unit for Scotch Marine type boilers and other types of heat receivers designed for pressurized operation. Photos, specs in 6-page bulletin "Y," Ray Oil Burner Co, 1301 San Jose Ave, San Francisco 12, Calif.

23 **Heavy-oil burners,** belt driven horizontal rotary type, bulletin 175-H; combination oil-gas burner, bulletin 176; automatic combustion system, bulletin 185. Preferred Utilities Manufacturing Corp, 1860 Broadway, New York, N. Y.

MAINTENANCE MATERIALS

24 **Maintenance coatings** described in 4-page bulletin 400. United Laboratories, Inc, 16801 Euclid Ave, Cleveland 12, Ohio.

25 **Rust removing material** for simultaneous stripping of paint, rust and primer from ferrous metal surfaces. Four-page bulletin. Turco Products, Inc, 6135 S Central Ave, Los Angeles 1, Calif.

26 **Hot-melt plastic coating** for safeguarding gears and precision parts from corrosion. Four-page bulletin. Fidelity Chemical Products Corp, 470 Frelinghuysen Ave, Newark, N. J.

★ **Modern lubrication.** Types, descriptions, recommendations of proper lubricants in 36-page booklet 54-1. ★Request direct on company letterhead from Lubriplate Div, Fiske Brothers Refining Co, 129 Lockwood St, Newark 5, N. J.

MECHANICAL TRANSMISSION

27 **Right angle bevel gear** units for industry are illustrated and described in a 4-page catalog. With a 1:1 ratio, the gears' rated speed is 1800 rpm. Capacities 1/3 to 1 hp. Airborne Accessories Corp, 1414 Chestnut Ave, Hillside 5, N. J.

28 **Roller chain drives** is the subject of 52-page catalog CD-102-B. Sprockets have malleable split taper compression bushings. Photos and specs. Browning Mfg Co, Maysville, Ky.

29 **V-belts,** featuring patented *Grommet* belts in standard and high capacity constructions. Cutaways and hp rating tables in 8-page bulletin 2170. B F Goodrich Co, Industrial Products Div, Akron, Ohio.

30 **Clutch-coupling unit.** Applications and engr data in 4-page bulletin. Formsprag Co, 23601 Hoover Rd, Van Dyke, Mich.

31 **Speed control unit,** bulletin M-543 and motor pulleys, bulletin V-545. Two multi-color booklets showing photos, specs, applications of products. Reeves Pulley Co, Columbus, Ind.

(*Continued on page* 218)

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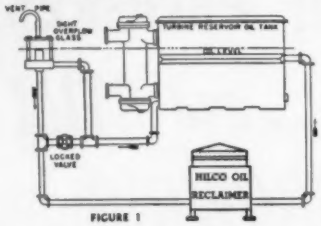

FIGURE 1

The HILCO system results in removing contamination as fast as it is formed, thus maintaining the oil in first class condition.

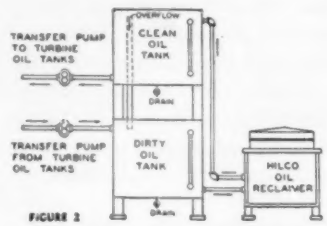

FIGURE 2

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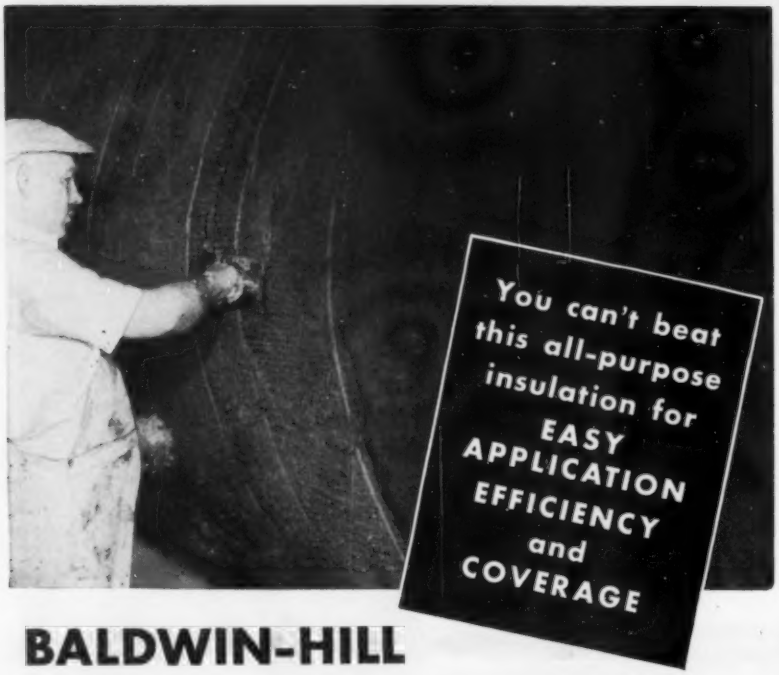
Baltimore	Cleveland	Houston	Milwaukee	New York	Rochester†	Waterbury
Boston	Dallas	Indianapolis	Minneapolis	Philadelphia	St. Louis	(†sales office only)

WANTED: **Power** readers

with insulation problems . . .



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No.1 INSULATING CEMENT

- Plastic insulation—easily troweled on large or small irregular surfaces.
- Effective up to 1800° F . . . Reclaimable to temperature of 1200° F.
- Low heat loss because of high temperature resisting mineral wool base.
- Coverage, 50 sq. ft. 1 in. thick per 100 lbs. . . . Low cost maintenance insulation.

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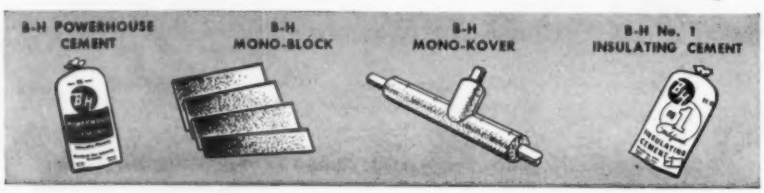
Kalamazoo, Mich. • Huntington, Ind. • Temple, Tex.

HOT OR COLD
IT NEEDS INSULATION
This Mineral Wool Insulation conforms to COMMERCIAL STANDARD CS-117-49 as issued by U.S. DEPARTMENT of COMMERCE
CERTIFIED BY MANUFACTURER No. 100



More FREE BULLETINS

Begins on page 165

32 **Heavy-duty chain drives.** Photos, operating principles, test data, capacities in 16-page catalog C72-51. Morse Chain Co, 7601 Central Ave, Detroit 8, Mich.

33 **Motoreducers.** Selection tables, dimensions, photos and specs in 28-page bulletin 3100. The Falk Corp, 3001 W Canal St, Milwaukee 8, Wis.

METERS and INSTRUMENTS

34 **Dynamometer systems** for testing internal combustion engines, transmissions, torque converters, compressors. Photos, applications, rating charts in 12-page bulletin GEA-5923A. General Electric Co, Schenectady 5, N. Y.

35 **Hot wire anemometer** for quantitative measurement of velocity. Applications and specs in 4-page bulletin 14. Flow Corp, 283 Concord Ave, Cambridge 38, Mass.

36 **Liquid level transmitter** for measuring liquid level in closed tanks under pressure or vacuum. Photos, specs in 4-page bulletin 2291. Minneapolis-Honeywell Regulator Co, Station 64, Wayne & Windrim Aves, Phila, 44, Pa.

37 **Dielectric test set** for measuring dc current at voltages to 40 kv. Diagrams, specs in four-page bulletin 22, James G Biddle Co, 1316 Arch St, Philadelphia 7, Pa.

38 **Outdoor metering outfits,** *type MP.* Photos and features in 4-page bulletin B-5916. Westinghouse Electric Corp, Box 2099, Pittsburgh 30, Pa.

39 **Panel instruments** in 2½, 3½ and 4½-in. sizes. Photos, construction, applications of both dc and ac instruments in 12-page bulletin GEC-368F. General Electric Co, Schenectady 5, N. Y.

VALVES, PIPING, FITTINGS

40 **Mudline valves;** 2000 psi WP (4000 psi test) and 3000 psi WP (6000 psi test) units. Construction data, diagrams, cutaways in 4-page bulletin 12-S. Edward Valves, Inc, 1201 W 145th St, E Chicago, Ind.

41 **Valve operator,** *Limitorque,* for small valves from 1½ to 8-in. part diameters. Photos, diagrams, applications in 4-page bulletin SMA-000. Philadelphia Gear Works, Erie Ave & G St, Philadelphia 34, Pa.

42 **Piston valves** and **drain cocks.** Two, four-page bulletins describing products. Photos, diagrams, specs. The Klinger Corp of America, 95 River St, Hoboken, N. J.

43 **Relief valves.** Photos, diagrams, technical data in 20-page bulletin 5200. Cochrane Corp, 17th St below Allegheny Ave, Philadelphia 32, Pa.

44 **Butterfly valves.** Photos, applications, specs in 16-page bulletin. Mud Products, Inc, Philtower Bldg, Tulsa 3, Okla.

45 **Ball valves,** manually-operated in sizes from 12 to 48-in. for shutoff service at pressures to 150 psi. Photos, specs in 8-page bulletin 159. Valve Div, S Morgan Smith Co, York 8, Pa.

46 **Plug valves** in full-port and venturi types to 14-in. size. Engr data, cutaways, dimenions in 24-page catalog 39-5. Homestead Valve Manufacturing Co, Coraopolis, Pa.

47 **Stainless steel unions** and check valves. Gives published analysis of steel used. Photos and cutaways in 22-page catalog 55. Clayton Mark & Co, 1900 Dempster St, Evanston, Ill.

48 **Steam traps.** Specs and capacities on steam and float traps, air release valves and pipe line strainers. Illustrated 36-page catalog. V D Anderson Co, 1935 W 96th St, Cleveland, Ohio.

49 **Underground conduit.** Applications, photos, diagrams and specs

How to Select an Economical Temperature Regulator

First of all, what does economy mean where temperature regulators are concerned? In some industries it means improvement of product or reduction of spoilage through closer control of process temperatures. In others, it means the paring down of operating expense. The price of the regulator itself is a relatively small factor.

Today's buyers are shopping for:

1. Accuracy of control — not only when the regulator is new, but throughout its service life
2. Dependability — to prevent loss of production time
3. Minimum installation and maintenance cost

Here are a few tips on what to look for when you're installing a new or replacing an old temperature regulator —

Packless construction . . . and for this reason: A diaphragm operated, packless regulator minimizes friction. There are no closely fitted parts to stick or bind because of uneven expansion or collection of foreign matter. Also, there's less maintenance, since no repacking is ever required.

A guarantee against wire drawing of the seats and discs. Insist on it. This guarantee in combination with single seat design assures you of tight shutoff; you avoid expensive steam losses as well as loss of product in a process application.

Broad control range. In a standard regulator you should expect a control range of 100 F. And make sure the unit you select has a vapor tension thermostat that can take over-temperatures of at least 100 F.

Easy maintenance. Why ask for grief? Your temperature regulator should be basically simple in design so that it can be serviced by average plant personnel. All parts should be readily accessible for testing and cleaning.

Double duty. There's no point in buying a separate pressure regulator when you can select a temperature regulator that combines both temperature and pressure control within the same unit.

Self-operating. Make sure you get a regulator that operates on its own initial pressure. By doing so, you avoid the purchasing and maintenance of an air compressor p'ıs air piping, and you're sure of uninterrupted operation during electric power failures.

• • • •

All of these points are important to you when it comes to selecting an economical temperature regulator. Perhaps you didn't realize you *could* expect so much. And perhaps you didn't realize that Spence Temperature Regulators offer all these features and more. May we send you our Bulletin T 500 containing further details? SE 130

SPENCE ENGINEERING COMPANY, INC.
Walden, New York

COME TO PHILADELPHIA

Dec. 2-3-4-6-7 1954

21st NATIONAL POWER SHOW

NATIONAL EXPOSITION OF POWER AND MECHANICAL ENGINEERING

COMMERCIAL MUSEUM — PHILADELPHIA

LEARN HOW YOU CAN MODERNIZE POWER FACILITIES

Concentrated under one roof you will see the newest improvements and refinements in power generation, transmission, utilization. Learn how these methods will help to modernize your power facilities—

The latest techniques for the maximum development and most economical utilization of power will be demonstrated by the skilled technicians manning every booth. Whether you are interested in mechanical, steam, electrical, hydraulic or pneumatic power, you will be sure to find ideas that will repay you many times over.

When going to the A.S.M.E. meetings, be sure to plan a stop-over at Philadelphia to see the Power Show.

PLAN NOW TO ATTEND

Write early for hotel reservations and advance registration

Under the auspices of the ASME

Mangagement: International Exposition Co., 480 Lexington Ave., New York 17, N. Y.

More FREE BULLETINS

Begins on page 165

in 24-page bulletin. Water-Tight Underground Conduit, Box 12211, Houston 17, Texas.

★ **Wrought iron piping.** Technical data, analysis of piping systems in 32-page illustrated bulletin titled "Piping for Permanence." ★Request on company letterhead from Engr Service Dept, A M Byers Co, Pittsburgh, Pa.

50 **Pressure loss calculator** slide-chart enables user to quickly estimate steam line pressure drop and to indicate proper size steam valve needed for any pressure up to 1500 psi. Golden-Anderson Valve Specialty Co, 1241 Ridge Ave, Pittsburgh 33, Pa.

51 **Safety and relief valves,** Mipco catalog No. 82. 84-page book has tables and items of useful engineering information. Marine and Industrial Products Co, 3731-35 Filbert St, Philadelphia 4, Pa.

PRIME MOVERS and ACCESSORIES

52 **Mechanical drive turbine,** *type DP*, rated from 10 to 1200 hp and 1000 to 6500 rpm. Applications, cutaways, photos in 20-page bulletin GEA-4955B. General Electric Co, Schenectady 5, New York.

53 **Velocity stage turbines,** *class CA* for mechanical drive, operates under all inlet steam conditions to 600 psig and 750 F. Cutaway, specs and dimensions in 4-page bulletin 4202, De Laval Steam Turbine Co, Trenton 2, N. J.

54 **Turbine speed control.** Illustrated 30-page bulletin H-21 intended to clarify operation of common automatic speed controls for steam turbines. Elliott Co, Jeanette, Pa.

55 **Piston rings** for engines and compressors. Photos, specs, engr data, applications in 36-page catalog 470. C Lee Cook Manufacturing Co, Inc, Louisville 3, Ky.

PUMPS

56 **Centrifugal pump,** *type GS*, has capacities to 400 gpm, heads to 230 ft, three sizes 2½ to 4-in. Photos, cutaway, specs in 4-page bulletin 1001B, De Laval Steam Turbine Co, Trenton 2, N. J.

57 **Metering and proportioning** pumps. Six-page bulletin KP54 explains operation, illustrates design features, gives capacity and pressure information. Hills-McCanna Co, 3025 N Western Ave, Chicago 18, Ill.

58 **End suction centrifugal pumps.** Photos, cutaways, performance tables, dimensions in 12-page bulletin 4011. The Deming Co, Salem, Ohio.

59 **Centrifugal pumps,** saddle mounted, vertically split, for heavy duty in boiler circulation and heater drain services. Bulletin W-341-B11B, Worthington Corp, Harrison, N. J.

60 **Cradle mounted pumps.** Design and construction features, cutaways, dimensions, specs in 4-page bulletin 247. Warren Steam Pump Co, Inc, Warren, Mass.

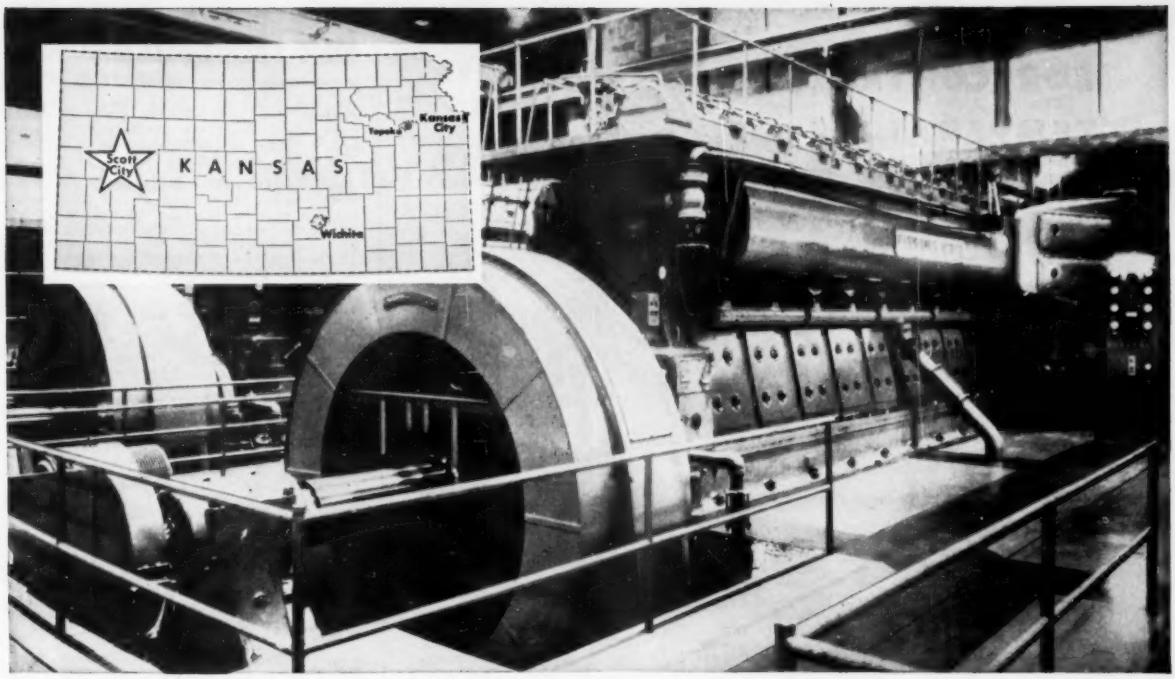
MATERIALS HANDLING

61 **Cable trays and fittings.** Photos, diagrams, descriptions, specs in 12-page bulletin. Fab-Weld Corp, 3650 Richmond St, Philadelphia 34, Pa.

62 **Crushers** for reducing all types of wet, sticky materials. Photos, specs in 12-page bulletin 864. Jeffrey Manufacturing Co, Columbus 16, Ohio.

63 **Skip hoists** is the subject of 16-page two-color catalog 110. Shows sequence views of operations of loading gates, bucket hoists and skip hoists. Includes dimensions, specifications and applications. C O Bartlett & Snow Co, 6037 Harvard Ave, Cleveland 5, Ohio.

64 **Endless chain conveyors** are described in a bulletin showing the *Flowmaster* conveyor. Can carry grain,

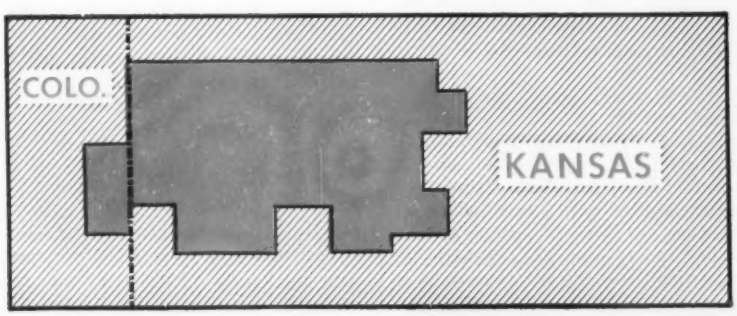


Largest REA Plant in Kansas Reports Cities Service DC-840 Diesel Oil Excellent!

Fairbanks-Morse Diesels of Wheatland Electric Cooperative, Inc. give outstanding performance using DC-840 Oil for power cylinder and crankcase lubrication. Here are the results Wheatland achieved:

1. House operation each unit—13,000 hours.
2. No oil changes due to oil failure.
3. No overhaul or major breakdown.
4. Rings free in groove with little or no signs of wear.
5. Oil consumption within mfgr's. recommendation.
6. Fuel consumption 10,572 BTU/KWH, load factor 63.7%.
7. Maintenance of lubricating oil at minimum expense.
8. 3500 H.P. hours per gallon of lubricating oil.
9. No wear on main or rod bearings.
10. No oil change at end of 9,000 hours.

For similar results in your Diesel operation, contact your nearest Cities Service office or write to Cities Service Oil Company, Sixty Wall Tower, New York 5, N. Y.



WHEATLAND ELECTRIC COOPERATIVE, INC. serves 3,300 square miles in all or part of Scott, Wichita, Hamilton, Greeley, Kearny, Wallace, Logan and Finney Counties in Kansas as well as sections of Kiowa and Prowers Counties in neighboring Colorado. Also supplies wholesale the Lane-Scott Cooperative serving 2,200 square miles in 6 Kansas Counties.

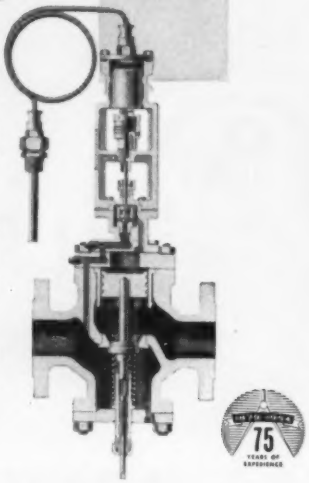
CITIES SERVICE

QUALITY PETROLEUM PRODUCTS

FOR CONTROLLING TEMPERATURE OF LIQUIDS OR GASES

TEMPERATURE REGULATORS

FOSTER TYPE T



Foster manufactures a complete line of temperature regulators for all types of service — for hot water storage heaters, fuel oil heaters, pasteurizers, ovens, driers, cookers and other process heating and cooling equipment.

They are available in single or double-seated construction; direct or reverse acting; in combination with pressure reducing valves; and in proper materials for the type of service.

Like all Foster valves, they are designed and built for long life with a minimum of maintenance, and are easy to service when necessary. Ask for Bulletin T-101.

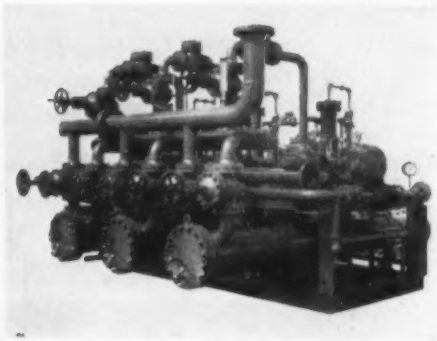
75 YEARS OF EXPERIENCE

FOSTER ENGINEERING COMPANY

835 LEHIGH AVENUE — UNION, N. J.

AUTOMATIC VALVES • SAFETY VALVES • FLOW TUBES

LOCKETT FUEL OIL PUMPING AND HEATING SETS



The compact, high-pressure Unit shown consists of one Turbine-driven and two Motor-driven Pumps, and three Shell-and-tube-type Oil Heaters mounted on a single frame. Capacity 50,000 pounds per hour of bunker C fuel oil against 400 P.S.I. One pump and heater are spares.

Custom Built

For more than a half-century, Lockett has been supplying standard and custom-built Fuel Oil Pumping and Heating Sets, for mechanical and steam atomizing oil burners. Various types of Pumps are available: Turbine or Motor-Driven Rotary Pumps, Electric-driven Rotary Pumps, and Duplex Steam Pumps, in any combination. Units can be furnished for any capacity or pressure desired; complete with Strainers, Pressure and Temperature Controls, and Instruments. Engineered to your requirements. Completely assembled and shop-tested. Inquiries are invited. *Descriptive bulletins sent on request.*

A. M. LOCKETT & COMPANY, LTD.

Contracting Mechanical Engineers

NEW ORLEANS • HOUSTON • DALLAS

More FREE BULLETINS

Begins on page 165

resins, fine chemicals, pigments and other free-flowing materials in horizontal, vertical or inclined planes. Gifford-Wood Co, Hudson, N. Y.

65 **Hydraulic adjustable** docking ramp is explained and illustrated in descriptive sheet. With a 20,000-lb capacity, the ramp is available in standard 6-ft width with lengths from 5 to 10 ft. Controlled by pushbuttons. Rowe Methods, Inc, 2534 Detroit Ave, Cleveland 13, Ohio.

66 **Ratchet lever hoist** with capacities from ¾ to 15 tons is described in 8-page bulletin SP. Includes both roller and coil chain models and section on special equipment such as safety hooks. Features single and double locking pawls. Coffing Hoist Co, Danville, Ill.

67 **Vibrating conveyors** is the subject of 12-page bulletin 135-A. Illustrated with applications, charts and specifications. Hewitt - Robbins, Inc, Stamford, Conn.

WELDING

68 **Electrodes** for manganese steel welding. Photos and details on physical properties, applications and procedures. Four-page bulletin AR-5, Alloy Rods Co, 5133 Lincoln Highway West, York, Pa.

69 **Engine-driven welders.** Photos, specs and construction data in 8-page bulletin 1337. The Lincoln Electric Co, Cleveland 17, Ohio.

More POWER NEWS

Begins on page 150

a 27,000-hp project for 75-ft head on the Tobique River, a tributary of the St John.

Sites were also studied by the Engineering Board for storage reservoirs which will provide about 4,000,000 acre-ft. A large part of this will be made available by construction of Rankin Dam in Maine.

Below Grand Falls the river drops 287 ft to Fredericton, capital of New Brunswick. The Morrill, Beechwood and Hawkshaw power sites are in this section. Work started on the Beechwood development by New Brunswick Electric Power Commission, will be a run-of-river plant with two 45,000-hp units. When storage capacity has been developed a third unit will be added. The Commission's power system covers practically the whole province. It has an installed capacity of over 100,000 kw and generated 321,000,000 kwhr in 1953, an increase of 12% over 1952.

Five Pacific utilities to study power reactors

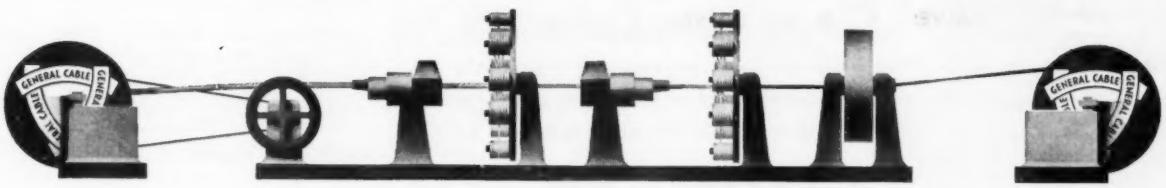
► THE ATOMIC ENERGY COMMISSION has entered into a one-year agreement with five Pacific Northwest utilities under which the companies will study the feasibility of designing and constructing a nuclear reactor for producing atomic power.

This is the 13th nuclear power study under the Commission's Industrial Par-

THE GREATEST NAME IN ELECTRICAL WIRE AND CABLE

BEAT THE HEAT

on electrical wires and cables at lower cost



With All-Asbestos and Asbestos-VC

BARE, WEATHERPROOF, INSULATED WIRES and CABLES FOR EVERY ELECTRICAL PURPOSE

General Cable All-Asbestos and Asbestos-Varnished Cambric wires and cables provide safe, sure wiring for power, control, apparatus leads and switchboard installations. Especially where heat is a factor or when resistance to flame, oil, grease or corrosive fumes is a must.

Better than other types of insulation, All-Asbestos and Asbestos-Varnished Cambric wires and cables permit higher current carrying capacities with the same conductor sizes or the same current carrying capacities with smaller conductor sizes. These wire and cable products are ideal for installation near furnaces, ovens, boilers and in similar hot locations.

STANDARD CONSTRUCTIONS

	Insulation	Covering	Conductor
ALL-ASBESTOS	Asbestos	Asbestos braid, or without covering	Solid, stranded, flexible copper or aluminum
ASBESTOS-VC	Asbestos and Varnished Cambric Asbestos and Gencaseal (polyvinyl plastic)	Asbestos Braid Cotton Braid Lead Sheath	Solid, stranded, flexible copper or aluminum

Whatever your wire or cable problem—only General Cable makes and can supply every type you need. For future electrical needs—it pays to *wire bigger* when building new, *wire bigger* when re-wiring, too! See your courteous General Cable Representative today!

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Long-lasting insulation protection is assured by Mundet insulation products and Mundet contract services. Our complete line of industrial insulations includes

MUNDET TRI-CALITE

Calcium Silicate Heat Insulation for temperatures up to 1200°F, in pipe covering and block forms. This lightweight, low density insulation is economical to ship . . . easy to handle . . . and has proved DURABILITY! Return the coupon for full information on Tri-Calite Insulation, and a free Thermal Conductivity Calculator.

MUNDET CORK CORPORATION, Insulation Division
7109 Tonnelle Ave., North Bergen, N. J.

Without obligation, send me a Thermal Conductivity Calculator free, and full information on Mundet Tri-Calite Heat Insulation.

NAME .....

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Mundet Insulation Products include: "Custom-Molded" 85% Magnesia Pipe Covering; Magnesia Blocks and Segmental Covering; High Temperature Pipe Covering and Blocks; "Jointite" Cork Pipe Covering and Corkboard . . . for all temperature ranges.

More POWER NEWS

Begins on page 150

ticipation Program, and the first in the northwest. Included in the project are the Montana Power Co, Washington Water Power Co, Pacific Power and Light Co, Portland General Electric Co, Mountain States Power Co.

Coming Events

Sept 15-21—Instrument Society of America, first international exposition and congress, Commercial Museum, Philadelphia, Pa. Information from Richard Bimbach, 845 Ridge Ave, Pittsburgh, Pa.

Sept 28-Oct 1—Association of Iron and Steel Engineers, annual convention and exposition. Cleveland Public Auditorium, Cleveland, hio. Details from AISE, 1010 Empire Bldg, Pittsburgh, Pa.

Oct 4-6—American Institute of Electrical Engineers, national electronics conference. Hotel Sherman, Chicago. Details from AIEE, 33 W 39th St, New York 18, N. Y.

Oct 5-7—American Institute of Electrical Engineers, Middle-Eastern district meeting. Abraham Lincoln Hotel, Reading, Pa. Details from AIEE, 33 W 39th St, New York 18, N. Y.

Oct 11-15—American Institute of Electrical Engineers, fall general meeting. Morrison Hotel, Chicago, Ill. Details from AIEE, 33 W 39th St, New York 18, N. Y.

Oct 12-15—Eighth National Chemical Exposition, Chicago Coliseum, sponsored by Chicago section, American Chemical Society. Further details from the office of the Exposition at 86 Randolph St, Chicago 1, Ill.

Oct 13-16—National Industrial Conference Board, annual conference on atomic energy in industry. Hotel Commodore, New York. Details from National Industrial Conference Board, 247 Park Ave, New York 17, N. Y.

Oct 14-15—Illinois Institute of Technology, tenth national conference on industrial hydraulics. Sheraton Hotel, Chicago. Details from Illinois Institute of Technology, 35 W 33rd St, Chicago 16, Ill.

Oct 18-20—Engineers Society of Western Pennsylvania, fifteenth water conference. Hotel Wm Penn, Pittsburgh. Information from ESWP, Hotel Wm Penn, Pittsburgh 30, Pa.

Oct 18-22—42nd National Safety Congress and Exposition, Hotels Hilton, Congress, Morrison, LaSalle and Palmer House. Information from R L Forney, general secretary, National Safety Council, 425 N Michigan Ave, Chicago 11, Ill.

Oct 22-23—Institute of Power Engineers, annual convention, Windsor, On-

SPRINGFIELD BOILERS

ANOTHER REPEAT ORDER STORY

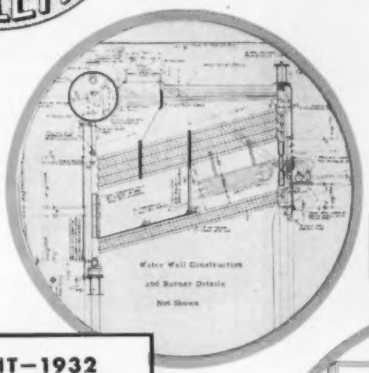
CITY OF COLORADO SPRINGS

Builds New Power Plant

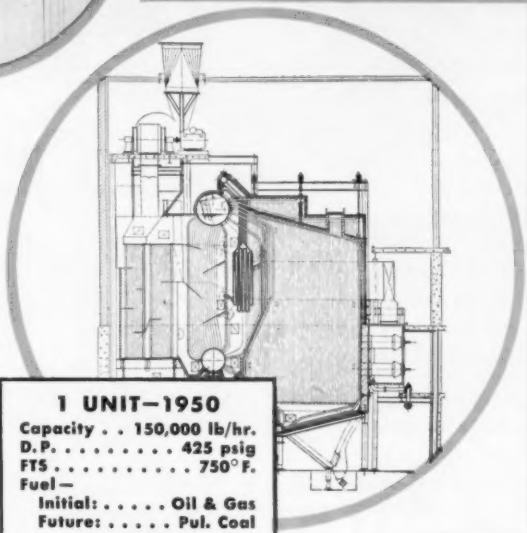
SPRINGFIELD Selected for 3rd Time!

This latest installation more than doubles the City's capacity at—

1. Higher Pressure
2. Higher Temperature



1 UNIT—1932
Capacity . . . 55,000 lb/hr.
D. P. . . . . 430 psig
FTS . . . . . 750° F.
Fuel . . . . . Gas & Oil



1 UNIT—1950
Capacity . . 150,000 lb/hr.
D. P. . . . . 425 psig
FTS . . . . . 750° F.
Fuel—
Initial: . . . . . Oil & Gas
Future: . . . . . Pul. Coal
Consulting Engineers:
LUTZ & MAY
Kansas City, Mo.

SPRINGFIELD PROVIDES

- Sound Engineering Design
- Superior Craftsmanship
- Reasonable First Cost
- Ease of Operation
- Low Operating Cost
- Guaranteed Performance
- Minimum Down Time
- High Efficiency

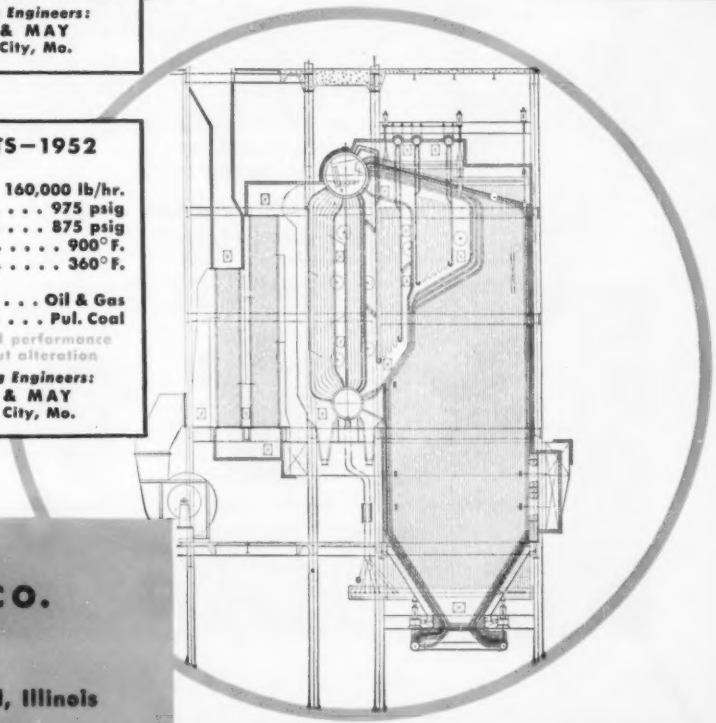
SEE SPRINGFIELD in SWEETS

The City of Colorado Springs' third order for Springfield Generators gives the City a total installed capacity of over a half million pounds of steam per hour. The two latest units, housed in a new plant, are designed for 975 psig with an attemperator controlled final steam temperature of 900 deg. F., following the trend of higher pressures and higher temperature for greater overall economy.

F. H. Wiley, Supt. of Electric Div., Dept. of Utilities, City of Colorado Springs, and the Consulting Engineers are just a few of the many who have found it advantageous to "repeat with Springfield" when expanding. One large midwestern manufacturer has purchased 28 Springfield Steam Generators.

Many Consulting Engineers have favored Springfield with repeat recommendations. They always find Springfield helpful and cooperative not only in the preliminary design stage and right on through to completion, including training of the Purchaser's operating personnel, but also throughout the life of the unit.

Check with Your Consulting Engineer on Modernization and New Plant Projects



2 UNITS—1952
Capacity—
each . . . 160,000 lb/hr.
D. P. . . . . 975 psig
O. P. . . . . 875 psig
FST (Con.) . . . . . 900° F.
FWT . . . . . 360° F.
Fuel—
Initial: . . . . . Oil & Gas
Future: . . . . . Pul. Coal
All predicted performance met without alteration
Consulting Engineers:
LUTZ & MAY
Kansas City, Mo.

WRITE FOR SPRINGFIELD'S 1954 CATALOG

Worldwide Sales and Service

SPRINGFIELD BOILER CO.

FOUNDED IN 1890

DIVISION OF *John W. Hobbs Corporation*

1953 E. Capitol Avenue • Springfield, Illinois

USE STRONG* STRAINERS -for *better* protection!

For steam, air, water and gas. STRONG'S new "Y" type strainer is ideal for the protection of steam traps, reducing valves, temperature controls, air control equipment, pumps, etc.

A HIGH-QUALITY, LOW-COST STRAINER!

★ **Monel Screen**—Mesh cloth in sizes ¼" to ⅜", larger sizes standard with .027 perforations. Self-centering guides prevent crushing.

★ **Semi-steel Body**—For rugged service. Sizes ¼" to 2". For steam pressures to 250 psi, cold pressures to 400 psi.

★ **Easy Installation**—New V-shaped gripping lugs on inlet and outlet bosses—may be easily installed with any type wrench.

CAST STEEL "Y" STRAINER

Available for pressures to 600 psi, screwed and flanged. Sizes ¼" to 4".

Send for Catalog 68-P today!

*Reg. Trade Mark

STRONG, CARLISLE & HAMMOND COMPANY

1392 West 3rd Street
Cleveland 13, Ohio

ANUM-METL Reg. Trade Mark

OTHER STRONG STEAM SPECIALTIES

No. 070 Small Trap | 80 Series Trap | "T" Type Strainer

STRONG

More POWER NEWS

Begins on page 150

tario. Details from W G Child, IPE, 410 Bloor St East, Toronto 5, Ontario, Canada.

Nov 1-5—American Welding Society, fall meeting. Sherman Hotel, Chicago. For details write AWS, 33 W 39th St, New York 18, N. Y.

Nov 1-5—American Society for Metals, national metal exposition. International Amphitheatre, Chicago. Details from ASM, 7301 Euclid Ave, Cleveland 3, Ohio.

Nov 10-12—Industrial Management Society, annual time and motion study and management clinic. Sherman Hotel, Chicago. Details from IMS, 35 E Wacker Dr, Chicago 1, Ill.

Dec 2-7—21st National Exposition of Power and Mechanical Engineering, Commercial Museum, Philadelphia. Details from International Exposition Co, 480 Lexington Ave, New York 17, N. Y.

Steel forms speed concreting at two hydro-power projects

► STEEL FORMS ARE being used to speed concreting operations at Chief Joseph and The Dalles hydro-power projects on the Columbia River. Blaw-Knox Co supplied the bulk of these forms.

At Chief Joseph the 20 draft tubes were shaped around one set of four-section, wood-lagged steel forms. This eliminated time-consuming carpentry work previously required for construction of individual draft-tube forms. The steel forms are built in sections for easy handling. They have proved so successful at Chief Joseph that similar forms have been ordered for The Dalles project.

The 2,700,000-hp Chief Joseph installation, near Bridgeport, Wash., is to be in operation in late 1955. The 2,726,000-hp The Dalles project, on the Washington-Oregon border, is scheduled for 1957 operation.

Teflon fiber is highly resistant to heat, chemicals

► "TEFLON" TETRAFLUOROETHYLENE FIBER, developed by duPont, is now being produced in experimental quantities. Development of the fiber expands uses of this material which is now produced in such forms as plastic molding powder, certain finishes and impregnated glass fabrics and tapes.

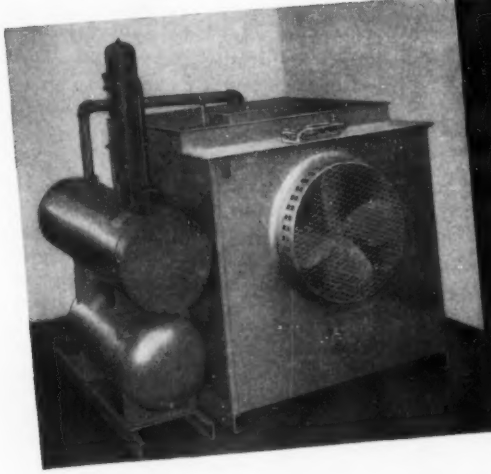
Teflon has a high mechanical strength over a wide range of temperatures. It retains useful strength to over 400 F, and for some applications over 500 F. Impact strength is high at –90 F.

The fiber is said to restrict action by sulfuric, nitric and hydrochloric acids.

New

SAVES WATER and CUTS MAINTENANCE COSTS . . .

Illustrations show two views of a 55 ton Condenser Tower prior to partial disassembly for shipment.



Vogt

CONDENSER TOWER

FOR CONDENSING REFRIGERANTS

SINGLE RESPONSIBILITY:

Vogt, leading builder of refrigeration condensers, assumes responsibility for engineering the unit. Only one purchase order needed.

SHOP FITTED:

To cut down field assembly labor. Requires no cutting or fitting of pipe.

Designed for today's water conservation requirements, and to keep refrigeration costs low, the *new* Vogt Condenser Tower meets the need for a proven, readily cleanable condensing unit.

The Vogt Condenser Tower consists of a multipass straight tube condenser, a receiver, an oil trap, a cooling tower, and a water pump. Removable cast iron heads permit easy cleaning of the condenser tubes.

Water costs are extremely low since the cooling water is recirculated continuously and requires only a small amount of makeup to replace losses due to windage and evaporation.

Condenser Tower units are available in capacities ranging from 5 to 50 tons refrigeration. Additional information will be furnished upon request.

HENRY VOGT MACHINE CO., Louisville 10, Kentucky

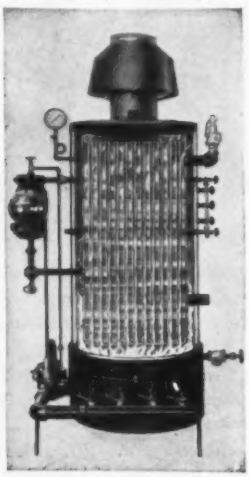
BRANCH OFFICES: NEW YORK, PHILADELPHIA, CLEVELAND, CHICAGO, ST. LOUIS, DALLAS, CHARLESTON, W. VA.

M-K-O AUTOMATIC BOILER FEED UNIT..

Returns Condensate and Make-up Water, Keeps Constant Water Level

M-K-O AUTOMATIC BOILER FEED UNITS are designed to *automatically* pump hot condensate, plus any required make-up water, into a boiler, *without manual attention:* to maintain a practically constant water level at the point most economical for highest boiler efficiency; and to supply small quantities of hot water to the boiler at frequent intervals, thus eliminating the steam pressure drop incident to the old method of injecting large quantities of cold water at infrequent intervals. Boiler life is also prolonged by feeding hot water instead of cold water.

Our helpful, new Boiler Feed Bulletin, No. 4G, will gladly be sent upon request.



This is the KANE Boiler, built to A.S.M.E. specifications, in sizes to 30 H.P.

MEARS KANE O'FELDT INC.

DIVISION OF S.T. JOHNSON CO.

CHURCH ROAD, BRIDGEPORT, PA.

Sales Office:
108-22 Queens Blvd., Forest Hills 75, N. Y.

More POWER NEWS

Begins on page 150

as well as aqua regia. It is affected by fluorine gas and chlorine trifluoride at high temperature and pressure, and by molten-alkali metals.

It has good electrical properties, is non-flammable, but will melt with decomposition. Moisture absorption is zero.

Projected end-uses for Teflon fiber include liquid-filtration fabrics, gas-filtration fabrics, packing for pump and valve shafts, gaskets for flanged piping, special conveyors and beltings, valve diaphragms, electrical tapes.

Celebrate 100th anniversary of Roots blowers

► THIS YEAR MARKS the hundredth anniversary of the Roots blower principle. Discovered in 1854 by Francis and Philander Roots, this principle for creating positive mass movement of air or gas has remained basically unchanged to date.

Here's how it works: figure-eight shaped impellers revolve, scooping in a measure of air at the intake, carrying it around to the outlet.

According to the present manufacturers, Roots-Connersville Division of Dresser Industries, Inc, the discovery came about accidentally when the Roots brothers tried to improve a waterwheel for their Connersville, Ind, woolen mill.

AEC authorizes two heavy-particle accelerators

► THE ATOMIC ENERGY COMMISSION will provide $1,200,000 each for construction of heavy particle accelerators at Yale University and the University of California.

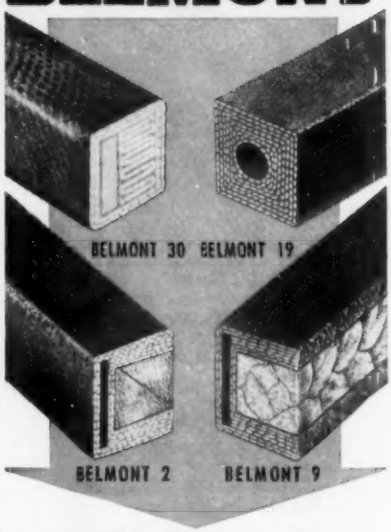
Both machines will be linear accelerators that will accelerate nuclei to an energy of approximately 10 million electron volts for each particle in the nucleus. Bombarding nuclei will then be able to interact with the heaviest known elements.

The Yale machine will be used principally in studies of the physics of very heavy particle nuclear interactions. The Berkeley machine will be used primarily by the Radiation Laboratory's nuclear chemistry group.

First high frequency light system installed at Union

► A HIGH-FREQUENCY fluorescent lighting system, designed to produce about 25% more light than present systems, will be installed in the newly constructed Union College Alumni Memorial Field House at Schenectady, N.Y. The lighting system represents the first gen-

They come from BELMONT



The Home of Packing Specialists

Any BELMONT Packing, properly fitted, outlives its original cost value many times over because of its longer lasting endurance and reliability.

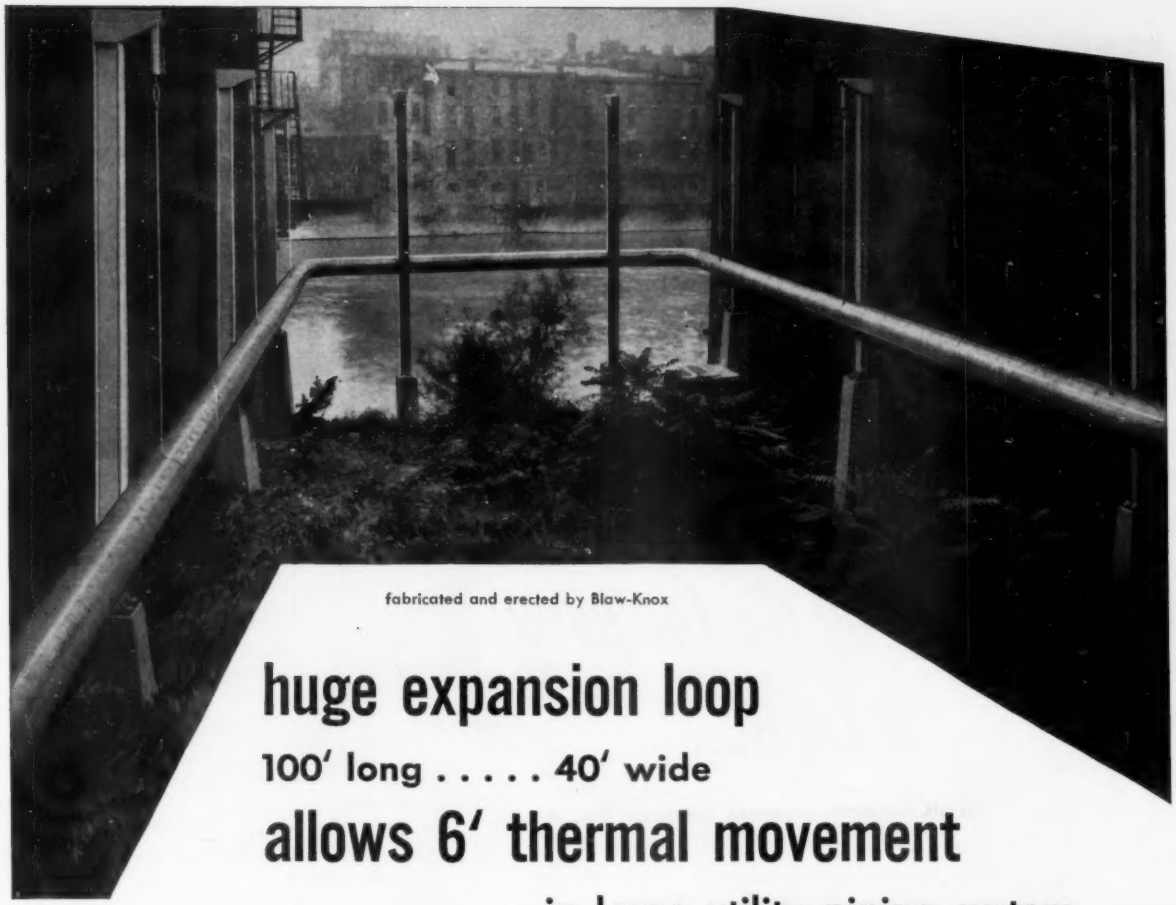
Where GOOD LONG-LIVING QUALITY is a *MUST* — THERE IS A BELMONT PACKING OR GASKET TO FIT YOUR *EVERY* NEED! Whether for minimum hot or cold oil penetration and saturation . . . For maximum resistance against extreme temperature changes . . . For a higher flexibility and resiliency on high pressure steam rods and hammers, expansion joints, air rods . . . For more continuous free motion of shafts working against steam, hot or cold water, oil, acids . . . In fact, for *all* types of Packing services, you'll always find a BELMONT standard or specially constructed BELMONT PACKING to answer your problem.

WRITE US FOR THE NAME AND ADDRESS OF YOUR NEAREST BELMONT DISTRIBUTOR. 4-P-5A

for Steam • Water • Oil • Gas • Air
Acids • Alkalies • Ammonia

THE BELMONT PACKING AND RUBBER CO.
Butler and Sepviva Streets
Philadelphia 37, Pennsylvania

Rings • Spirals • Coils • Reels
Spools • Sheets • Gaskets
There's a Belmont Packing for every service



fabricated and erected by Blaw-Knox

huge expansion loop

100′ long . . . . . 40′ wide

allows 6′ thermal movement

. . . in large utility piping system

This tremendous expansion loop is only one part of a ten-inch power piping line which carries steam at 650# pressure and 750° Fahrenheit for nearly a mile throughout the downtown area of a large city. All bends were fabricated in our shops . . . and installed in the field by our service force, using Blaw-Knox functional hangers and vibration eliminators.

An unusual job . . . and you'll probably never need one just like it. But it points up the kind of service we offer you. For we have the experience and the facilities to handle any type of piping problem.

On a job you place with us, you'll have the benefits of modern shop facilities for hot and cold bending, welding and fabricating all types of piping. A metallurgical research laboratory to assure you of the latest developments in high pressure, high temperature piping. Newest types of testing equipment to insure the soundness and strength of the piping under the most severe operating conditions.

And in addition, a complete service force equipped with modern machinery for field erection . . . and the necessary manpower to handle any size job.

What's your power piping problem?

We are prepared to (1) engineer, fabricate and erect your job . . . (2) simply fabricate and erect . . . or (3) fabricate only.

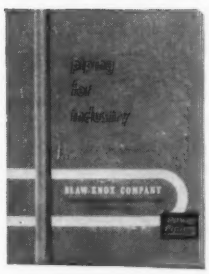
Our engineers will quote from your drawings . . . or, where desired, make a field study of your piping requirements before quoting.

Write us your requirements . . . and we'll provide the service you need.

BLAW-KNOX COMPANY

Power Piping and Sprinkler Division

Pittsburgh 33, Pennsylvania



To get more information on piping for industry write for your copy of Bulletin No. 2443.

BLAW-KNOX

POWER PIPING

Complete prefabricated power piping systems for all pressures and temperatures . . . plus complete line of functional spring hangers • rigid hanger assemblies • overhead roller assemblies • supports • vibration eliminators

Demineralization and Silica Removal

CATEXER® ANEXER® PLANTS

provide the low silica, low solids boiler feed makeup water so essential to the operation of high pressure boiler and turbine operation in the plants listed below.

Good Equipment is known by the Company it keeps....

- PUBLIC SERVICE CO. OF NORTHERN ILL.
  Waukegan, Ill. (3 bed – 250 g.p.m.)
- WISCONSIN POWER AND LIGHT CO.
  Sheboygan, Wis. (2 bed – 60 g.p.m.)
- WESTERN ELECTRIC CO.
  Hawthorne Sta., Chicago, Ill. (2 bed – 200 g.p.m.)
- INTERSTATE POWER CO.
  Dubuque, Iowa (2 bed – 30 g.p.m.)
- INTERNATIONAL PAPER CO.
  Natchez, Miss. (2 bed – 900 g.p.m.)
- INTERNATIONAL PAPER CO.
  Panama City, Fla. (2 bed – 1200 g.p.m.)
- CALIFORNIA ELECTRIC CO.
  High Grove, Calif. (2 bed – 40 g.p.m.)
- NATIONAL PETROCHEMICALS CORP.
  Ficklin, Ill. (2 bed – 400 g.p.m.)
- WISCONSIN POWER AND LIGHT CO.
  North Beloit, Wis. (2 bed & mixed bed – 40 g.p.m.)

for useful information
on sodium, hydrogen or anion exchangers...
write for INFILCO Bulletin 1960--K.

INFILCO

INFILCO INC. | *Tucson, Arizona*

Plants in Chicago and Joliet, Illinois

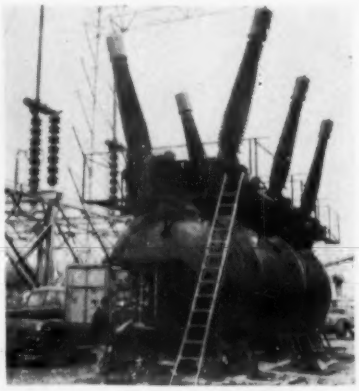
Field offices in 33 principal cities in the U. S., Canada and Mexico

More POWER NEWS

Begins on page 150

eral application over a large area of the high frequency fluorescent system.

The fluorescent lamps in the new field house will operate on 400-cycle power, instead of the standard 60-cycle current. The increase in current will be accomplished by a rotating type frequency converter operated by a 60-cycle motor. The new ballasts used to control the 400-cycle units are more efficient and 80% lighter than conventional ballasts. More than 2/3rds of a mile of fluorescent tubes will be used in the structure.



Mammoth circuit breaker to protect 330,000-v network

► AN 83-TON CIRCUIT BREAKER, largest ever built by General Electric Co, and one of the largest in the world, is installed at the Philip Sporn generating station at New Haven, W Va. The power plant is owned and operated jointly by The Ohio Power Co and Appalachian Electric Power Co of the American Gas and Electric System.

The breaker, designed to interrupt currents equivalent to 25,000,000 kva, will help protect the nation's first 330,000-v power transmission network. It is capable of interrupting power in a twentieth of a second should a short strike. After danger has passed, the breaker switches power back on with such speed that household lamps barely flicker.

L J Wing Mfg Co marks 75th year of operation

► L J WING MFG CO, of Linden, N. J., manufacturers of heating, ventilating and combustion equipment and steam turbines is currently celebrating its 75th continuous year in business. Founded in New York City in 1879, the present company was incorporated in 1903.

Wing products are sold throughout the world through some 70 sales offices. Company's line comprises steam, gas and electric unit heaters, fresh air supply heaters, door heaters, forced

THESE EXCLUSIVE PRECISION-MACHINED GUIDES

eliminate chatter

lengthen service life

IN LUNKENHEIMER

IRON BODY GATE VALVES

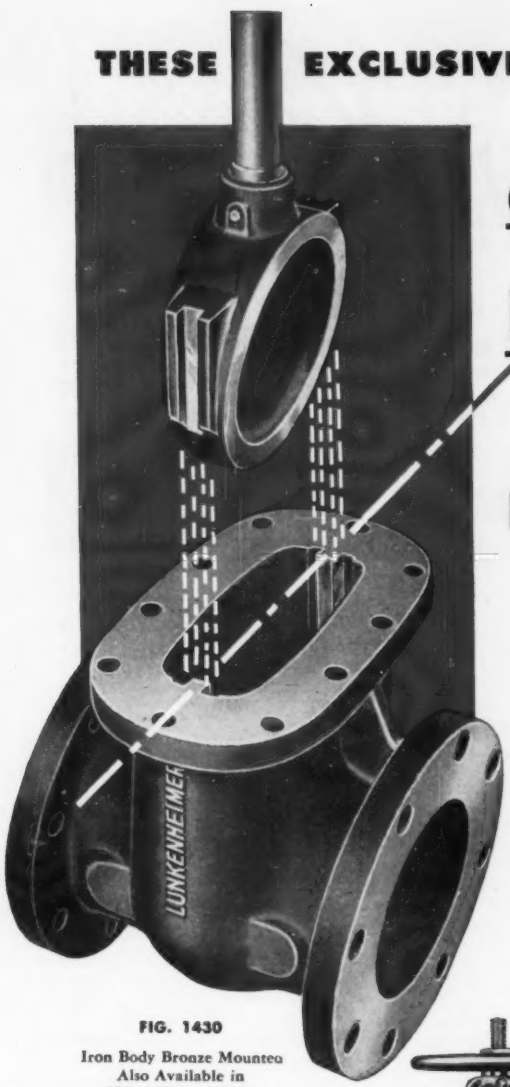
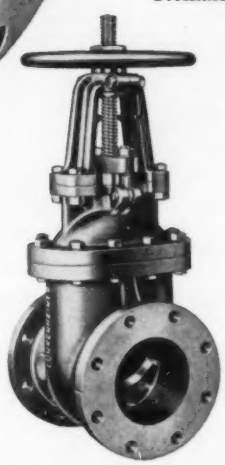


FIG. 1430

Iron Body Bronze Mounted
Also Available in
FIG. 1576 and 1578
All Iron
Screwed and Flanged Types

This exclusive machined-guide design is only one of the many original money-saving features of Lunkenheimer Iron Body Gate Valves. Gate valve chatter — the sound of wasteful, accelerated wear—is eliminated by Lunkenheimer's unique method of manufacture. Not only are the guide channels in the disc accurately machined, but the guides in the body, as well. These precision-machined guides hold the disc firmly in line as the valve is opened and closed — prevent pressure from forcing the disc against the opposite seat. Result: no clatter, no chatter, and much longer valve life. When repair is necessary, replacement parts can be easily installed without machining or fitting — an exclusive Lunkenheimer feature. In addition, Lunkenheimer Iron Body Gate Valves have long-wearing Stemalloy® Stems, bronze bushings that protect the stem from corrosion and scoring, and handy swing bolts and shelves that make repacking so easy. No other iron-body valve gives you so much *outstanding* value.



WRITE FOR Circular 564, describing the complete Lunkenheimer Iron Body Gate Valve line. Address: The Lunkenheimer Co., Box 360C, Cincinnati 14, Ohio, or phone your Lunkenheimer Distributor.

LUNKENHEIMER
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QUALITY

IRON • STEEL • BRONZE

LUNKENHEIMER®

THE ONE *Great* NAME IN VALVES

L-253-9A

More inches of VISIBILITY . . . and No Blind Spots with NEW Jerguson STEAM GAGES

Assembly No. 618

You get more inches of visibility within centers available . . . and no blind spots with the New Jerguson Steam Gages with the horizontal expansion loop. The special new compact valve, with a *horizontal* loop that keeps the strain off the gage assembly under varying conditions of expansion and contraction, gives you maximum gage room within the centers.

The special offset single piece gage chamber design with staggered glasses and covers gives you continous visibility of the water level *with no blind spots* between gage sections.

The gage can be turned at any angle, yet there are no stuffing boxes between gage and valves. The ingenius design of the assembly includes a bracket so the gage will always stay in vertical position. The OS&Y valves have renewable seats and are standard with quick closing stem for chain operation, as shown, or available with plain closing stems and chain wheels.

Made in three designs of single piece chamber: for one, two, or three section glass for any W.S.P. Any Jerguson standard gage may be supplied with stems and flanges for use with this expansion loop valve.

Write for full information on Jerguson New Steam Gages with Horizontal Expansion Loop Valves.

JERGUSON

Gages and Valves for the Observation of Liquids and Levels

JERGUSON GAGE & VALVE COMPANY
100 Fellsway, Somerville 45, Mass.
Offices in Major Cities
Jerguson Tross Gage & Valve Co., Ltd., London, Eng.
Pétrole Service, Paris, France

More POWER NEWS

Begins on page 150

draft fans and blowers, draft inducers, auxiliary steam turbines, duct fans, ventilating fans and industrial fog eliminators.

The company claims the rather unique record of having originated and pioneered everything that it manufactures.

World's largest gas turbine concentration

► THE NEW $25,000,000 oil-field repressurizing operation of Creole Petroleum Corp, Venezuela, represents the largest single concentration of gas turbines in the world. Located at Lake Maracaibo it will be used to pump gas back into the surrounding oil field to maintain subterranean pressure and increase the yield of oil.

General Electric Co supplied the system with a large master central control switchgear panel, ten smaller panels, ten 6,000-hp gas turbines, a pair of load center unit sub-stations, and an emergency generator drawout panel.

Closed circuit color TV ready for schools, business, industry

► GE HAS ANNOUNCED it is ready to supply color television systems for closed circuit use in schools, business and industry. Images are not broadcast with this equipment as they are from a commercial TV station, but are "piped" from television cameras through coaxial cables or over microwave relays to home-type receivers or large-screen TV projectors.

The system is the field-sequential developed by the Columbia Broadcasting System and built by General Electric under a patent license agreement. GE also is producing color TV equipment for broadcasting stations under this agreement.

In industry, closed circuit color TV is useful in supervision of remotely located or controlled conveyors, skip hoists, or other equipment and for inspecting the inside of boilers, furnaces and equipment which for some reason is impossible to inspect otherwise.

Fourth 120,000-hp unit for Ross-Dam hydro plant

► PLANS TO COMPLETE Ross hydroelectric plant on the Skagit River, Wash. have been announced by the Seattle Lighting Dept. The plant has three 120,000-hp units installed. A $1,146,845 contract for a fourth and last turbine has been awarded to Newport News Shipbuilding and Drydock Co. Full capacity of the plant will be 480,000 hp.

The 540-ft Ross dam provides 1,400,000 acre-ft storage and backs the water

Catawissa PERFECT SEAL Unions

HOT FORGED from solid, rectangular steel bars, designed and produced for dependable, long-life service under the severest piping conditions!

A TYPE FOR EVERY USE!
FOR ALL PRESSURES!
FOR ALL TEMPERATURES!

Standard & Double Extra Heavy
UNIONS
Available with screwed or socket weld ends. 3000-lb. sizes ⅛" to 3"; 6000-lb. sizes ⅛" to 2".

ORIFICE UNIONS
With screwed or socket weld ends. 3000-lb. and 6000-lb. service.

MALE & FEMALE UNIONS
With steel-to-steel, bronze-to-steel, stainless steel-to-steel or orifice seats. 3000-lb. service only.

FULL STAINLESS & FULL ALLOY STEEL UNIONS
With screwed or socket weld ends. 3000-lb. and 8000-lb. service.

WRITE FOR CATALOG 11
showing the complete Catawissa line of Perfect Seal products

CATAWISSA VALVE & FITTINGS COMPANY
206 MILL ST. • CATAWISSA, PA.

BREECHINGS · STACKS

AIR AND GAS DUCTS

PLATE FABRICATION FOR POWER PLANTS

KIRK AND BLUM
FABRICATION

Whatever your requirements in fabricated plate, sheet or structurals for power plant use . . . call on experts!

Kirk & Blum has fabricated a variety of power plant needs as big as the mammoth breeching section shown here. In a 150,000 sq. ft. plant, with crane capacity to 25 tons, Kirk & Blum has complete facilities to produce, pre-assemble and load the largest fabrication. Kirk & Blum has the men, materials and experience to do the job quickly and economically.

For detailed literature, write: The Kirk & Blum Mfg. Co.
3233 Forrer St., Cincinnati 9, Ohio

How to look at 500 lbs. of steam *safely*

Safeguard your eyes from scalding steam and flying glass. Watch your water level safely through SONDERGLASS, the safe gauge glass. Virtually two tubes in one . . . the outer hardened to resist cold drafts and erosion . . . the inner to withstand great heat.

Sonderglass has been dipped into 450°F oil and repeatedly plunged into cold water without spalling or cracking.

Today, equip your boilers with the safe glass — Sonderglass — and enjoy the satisfaction of knowing that you have the best.

SONDERGLASS

THE SAFE GAUGE GLASS

PACKING Chesterton SERVICE

NEW PRESSURIZED SPRAGRIP
First Effective Treatment for V Belts

Spragrip is an entirely new development and unlike any other belt dressing you have ever used. It is a permanent type dressing that gives an immediate power boost and will not lose its grip due to aging, oxidizing, glazing or drying out on the belt. Treat your V, flat, round, leather, rubber or fabric belts the easy way. Just press the button on the modern pressurized can of Spragrip and safely spray hard-to-reach sheaves and belts with this power boosting formula. The same formula is packaged in spout applicator cans under the trade name Belt-Flo. Money back guarantee. Write the A. W. Chesterton Co., Everett 49, Mass. for full information.

More POWER NEWS

Begins on page 150

to the Canadian border. A project to build the dam to its design height of 640 ft with a storage capacity of 3,450,000 acre-ft (part of which will be in British Columbia) is being negotiated with Canada.

Devises lightning protection for series capacitors

► RALPH E MARBURY, an engineer of Westinghouse Electric Corp, has invented a way to detour excessive current resulting from lightning or other short circuits on power lines and thus protect capacitors from damage.

Essentially, the idea causes a heavy surge of current to "leap frog" around the capacitors. The arc is then blown out by a blast of air and the capacitors take over their normal function.

Using this invention, Westinghouse has installed series capacitors on three high-voltage transmission lines of the Bonneville Power Administration.

AEC approves new nuclear power reactor studies

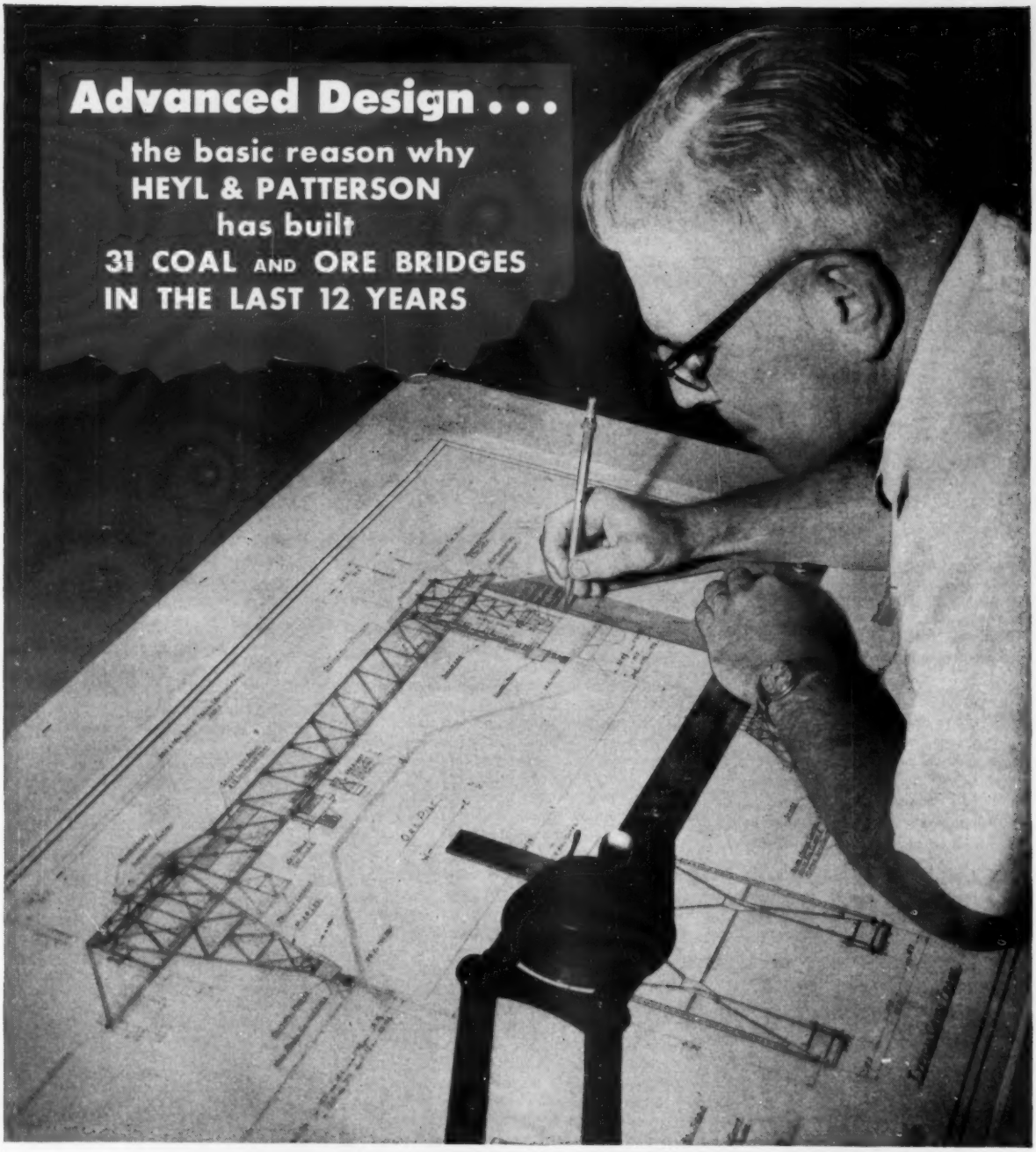
► UNDER A NEW AGREEMENT, the 26-firm Dow Chemical—Detroit Edison and Associates Atomic Power Development Project will begin a new phase of nuclear power investigations involving actual experiments and preliminary engineering.

The group will spend an estimated $2,500,000 on a detailed program of research and development on a breeder reactor for generating electric power and other products, and on related equipment and processes. Most of the money will be spent in industry-owned research facilities.

The new arrangement will run until Jan 31, 1955. The group will report on the desirability of further work on a nuclear reactor for commercial use, and proposed plans for development, design, construction and operation of such a reactor.

E K Stevens, vice-president and treasurer of International Exposition Company, has been elected president, succeeding the late Charles F Roth. Stevens also becomes manager of the National Exposition of Power and Mechanical Engineering, International Heating and Ventilating Exposition and the Exposition of Chemical Industries.

Deutsch and Loonan, New York, consulting engineers and metallurgists, have announced that David Aronson, formerly consulting engineer with Worthington Corp, has joined their firm. The organization offers its combined experience in metallurgical operations, heavy chemicals plant design and operation, power plant studies and heat transfer analysis and design.



The constant aim of Heyl & Patterson is engineering progress based on actual past experience and on modern thinking and planning . . . with the one objective of building better equipment.

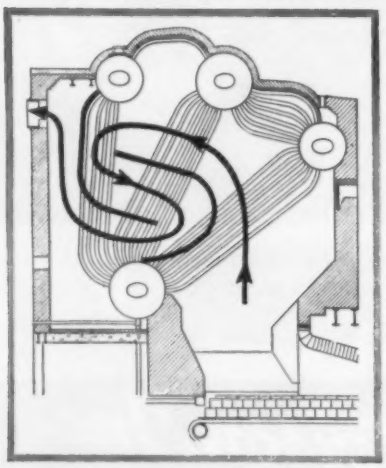
Ore Bridges
High Lift-Turnover-Rotary Car Dumpers
Boat Loaders & Unloaders
Coal Handling Equipment
Pig Iron Casting Machines
Cyclone Thickeners
Thorsten Coal Samplers
Car Hauls and Boat Movers
Coal Crushers
Bradford Breakers

Heyl & Patterson, Inc.
"SINCE 1887"
55 FORT PITT BLVD. PITTSBURGH 22, PA.

These important fuel-saving, maintenance-reducing features are obtainable with Enco boiler baffles — and only with Enco baffles.

- Streamlined gas flow
- Uniform gas flow
- Elimination of bottle necks
- Reduced draft losses
- Higher heat transfer
- Cleaner heating surfaces
- Less use of soot blower
- Special provision for expansion
- Easy tube replacement
- Adaptable to any water-tube boiler, fired by any fuel

Each application is designed on the basis of more than a quarter century of experience in this specialized branch of power engineering. Installations are made by skilled mechanics.



THE ENGINEER CO.
Enco 75 West St. New York 6, N. Y.

APPOINTMENTS

Corporation executive changes

Hagen Corp: W W Hopwood, president, succeeding David J Erikson, retired. **Walworth Co:** Fred W Belz, chief executive officer. **General Cable Corp:** Arthur Z Barnes, assistant to president. **Panellit, Inc:** Walter P Hooper, administrative vice-president. **Lincoln Electric Co:** James F Lincoln, chairman of board; William Irrgang, president and general manager; John S Roscoe, executive vice-president.

The International Nickel Co of Canada, Ltd: Henry S Wingate, president; Walter C Kerrigan, assistant to president; Herbert G Fales, assistant to chairman. **Combustion Engineering, Inc:** Robert L Riker, assistant to president. **American District Steam Co, Inc:** Harold W Dornsife, vice-president and general manager of California Steel Products Co, a subsidiary. **Foster Wheeler Corp:** Charles C Hornbostel, administrative assistant to president. **A-P Controls Corp:** A L Topp, vice-president, engineering.

Pacific Pumps, Inc: Elmer J Weis, executive vice-president; Erwin A Loth, vice-president, manufacturing. **H K Porter Co of Pittsburgh, Inc:** R F Allen, vice-president in charge of Buffalo Steel division. **The Midvale Co:** Richard T Nalle, president; Lewis W Metzger, executive vice-president; A O Schaefer, vice-president, engineering and manufacturing. **Pittsburgh Piping & Equipment Co:** Charles R Rall, chairman of the board; G Sinding-Larsen, president; Jos G Gardner, vice-president. **Hydropress, Inc:** Hugo Lorant, senior vice-president; Paul Mayer, assistant vice-president.

Operation executive changes

General Electric Co: William B Wilson, manager of industrial power generation unit. **Graver Water Conditioning Co:** Leonard Limon, manager of industrial boiler feed dept. **Rome Cable Corp:** Glenn Koger, manager of Torrance plant. **United States Rubber Co:** mechanical goods division: Chester J Noonan, executive general manager; H Leon Moran, new products manager; Herbert J Reid, factory manager of Fort Wayne plant.

Foster Wheeler Corp: John W Cartinhour, manager of nuclear energy dept. **Allis-Chalmers Manufacturing Co:** general machinery div; L B Gay, manager of Denver district succeeding Paul R Pollock, new Mid-Atlantic regional representative. **General Electric Co,** Carboloy dept: Peter J Jensen, manager of manufacturing. **Minneapolis-Honeywell Regulator Co;** R B Grant, manager of Los Angeles branch. **Bonney Forge & Tool Works:** Spencer H Mieras, general manager.

The Youngstown Sheet & Tube Co: Arch J Cochrane, manager of Chicago district, succeeding B M Stubblefield, retired. **Fuller Co:** Leonard R Constantine, manager of Catasauqua, Pa, plant. **Graybar Electric Co, Inc:** J L Bevers, manager of Wichita branch; R B Buffington, manager of Providence, R. I. branch. **Standard Pressed Steel Co:** Edward H Wheeler.

WATER CONDITIONING FOR INDUSTRY

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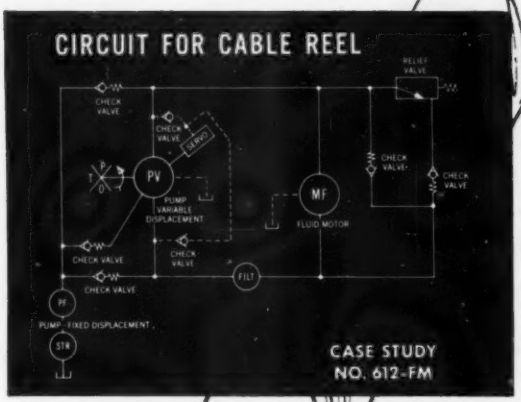

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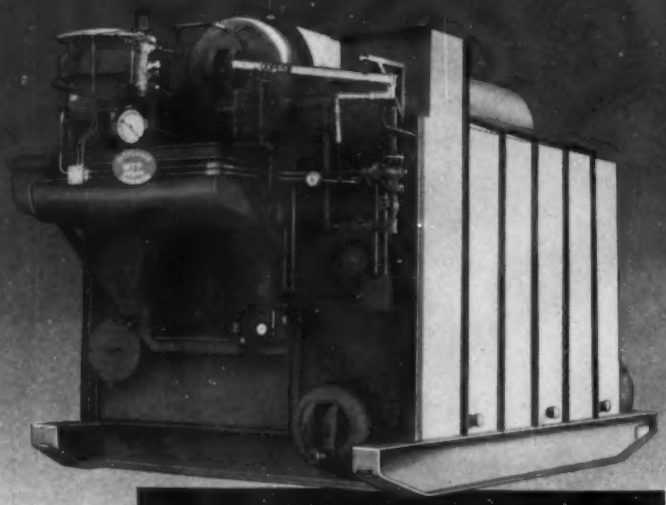

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More APPOINTMENTS

Begins on page 236

manager of forging division. **Westinghouse Air Brake Co,** Union Switch & Signal div; Warren C Dunn, supervisor of product sales. **M H Detrick Co:** Harry

Engineer changes

General Motors Corp, Hyatt bearing div: Carl W Kalchthaler, chief engineer. **Johns-Manville Products Corp:** George S Smith, director of engineering and vice-president. **Orr & Sembower, Inc:** Edgar A Burt, chief engineer. **Formsprag Co;** William T Cherry, mgr of application engineering.

Worthington Corp: E W Theilig, chief engineer, power pump engineering dept. **A M Byers Co:** William E Weber appointed field service engineer of San Francisco division. **General Electric,** Carboloy dept: Ernest E George named manager of magnetic products engineering.

Stone & Webster Engineering Corp: F W Argue, engineering manager. **Standard Pressed Steel Co:** John M Sherman, chief engineer. **Cooper-Bessemer Corp:** W R Crooks, chief engineer, development division; R F Lay, chief engineer, product division; T O Kuivinen, chief engineer, technical division.

New sales managers

Graver Water Conditioning Co: Harold R Fosnot. **Hagan Corp:** Gerald G Lipke, standard products; William F Waina, aeronautical and special products; John E Duesing, Pittsburgh district office. **Federal Electric Products Co;** Daniel P Lacock, Southeastern region. **Babcock & Wilcox Co:** N J Connor, New York district office. **Trane Co:** S Thomas Shimanski, Madison, Wis. branch office. **Dravo Corp:** George Heard, Pittsburgh heating dept. **Graybar Electric Co:** F M Sholders, Kansas City district. **Mineapolis-Honeywell Regulator Co:** Merrit Eusey, Pittsburgh branch; Robert S Warnick, Baltimore branch. **Worthington Corp:** G A Navrotsky, Middle East branch, Istanbul, Turkey. **Cooper-Bessemer Corp:** R B Scott, new Minneapolis branch. **Harnischfeger Corp:** Oliver Fuller, P&H Electrical Equipment. **Allegheny Ludlum Steel Corp:** David L Garrick, Milwaukee district.

New sales engineers

Robertshaw-Fulton Controls Co: Donald Daily and William H Johnson to Fielden sales staff. **J O Ross Engineering Corp:** Erwin G Hanson, main office. **Reliance Electric and Engineering Corp:** William C Prettyman, New York office. **Permutit Co:** Robert Fay O'Connell, St Louis office. **Flexonics Corp:** Harvey Wilson, field sales; Walter Keipper, office sales supervisor of expansion joints div. **National Supply Co:** M A Galvin, New York City office.

New distributors

For **Morse Chain Co:** Manufacturers Equipment and Supply Co, Flint, Mich; Schuman Steel Products Co, Bellingham,

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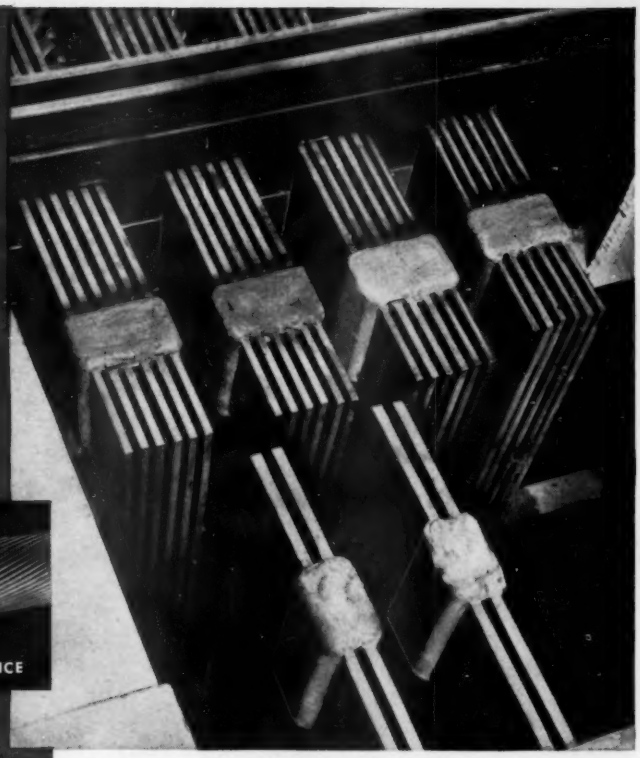

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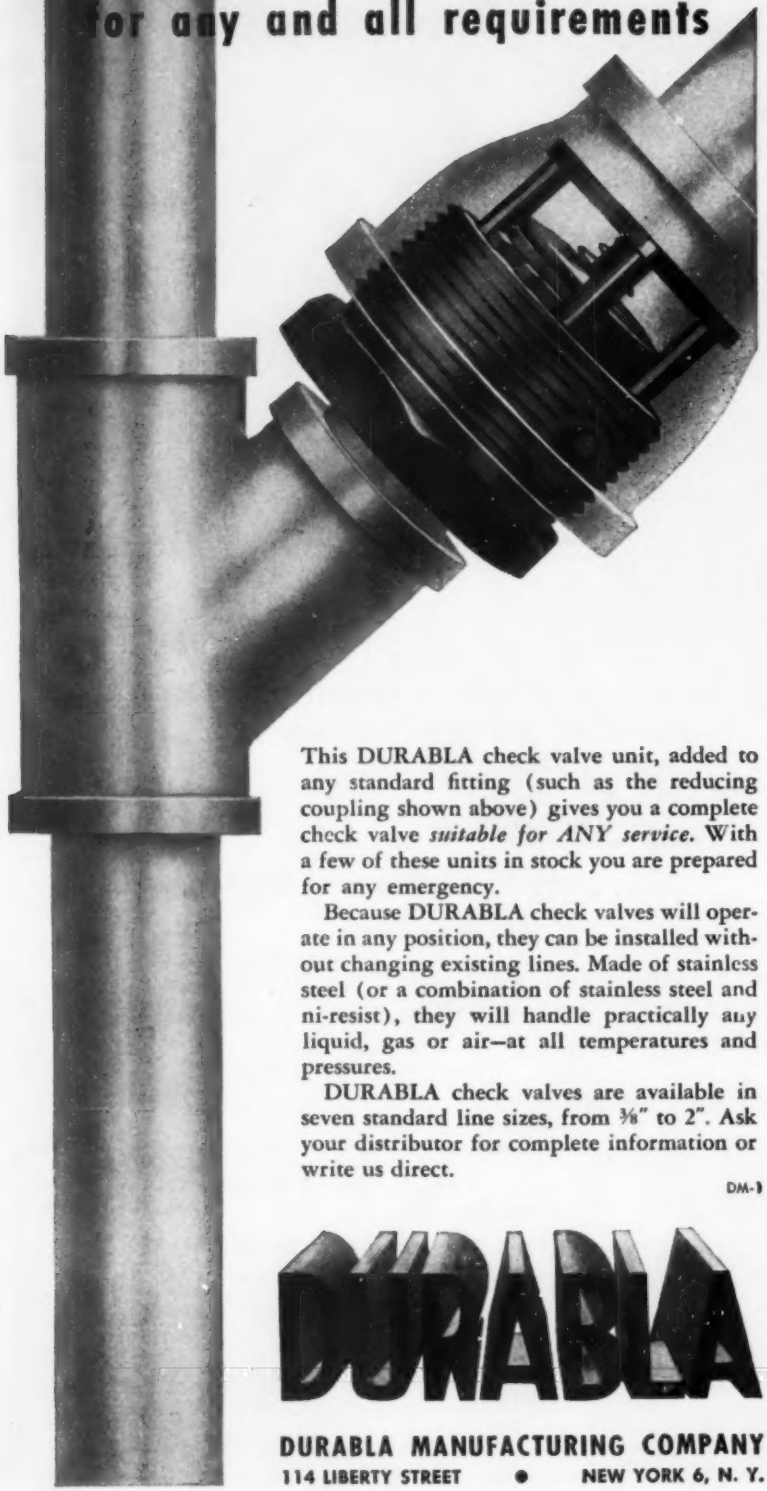

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More APPOINTMENTS

Begins on page 236

Wash; Jack Lee Machine and Supply Co, Attalla, Ala. For **Frick Co:** Central Ice Machine Co, 5015 S 24th St, Omaha, Nebr. For **Ampco Metal, Inc:** William M Orr Co, Inc, N Braddock Ave at Thomas, Pittsburgh 8, Pa. For **A-P Controls Corp:** Phillips Refrigeration Supplies Co, 1385 Imperial Ave, San Diego 1, Calif; Refrigerative Supply, Inc, 7 N 6th Ave, Yakima, Wash. For **Pyramid Steel Co:** Don D Fleming Co, Inc, 460 Bay St, San Francisco, Calif.

New representatives

For **Cleaver-Brooks Co:** Harold R White Co, 3600 4th St, Arundel Federal Bldg, Baltimore, Md. For **Helipot Corp:** Eltron Engineering, 246 Walnut St, Newtonville, Mass. For **Beaumont Birch Co:** Ellman Equipment Co, Cincinnati, Ohio.

For **DeLaval Steam Turbine Co:** Edward B Coffey & Co, Aparato 104, Guatemala City, Guatemala, C. A. For **Cuno Engineering Corp:** James A Plummer & Co, Middle Atlantic states. For **Swartwout Co:** I Russell Berkness Co, 615 E Franklin St, Richmond 19, Va.

New names

Tank Linings Inc, Merlin H Anderson, president. **General Electric Co's** commercial products dept renamed commercial and industrial air conditioning dept. **Federal Pacific Electric Co,** formerly named Federal Electric Products Co, Newark, N. J. **Hammer Valves Inc:** formerly named Hammer Oil Tool Co, Long Beach, Calif. **Industrial Gas Turbine Co,** 434 S Chester Pike, Glenholden, Pa., formed to manufacture and sell gas turbines and auxiliary equipment. **Crippen & Erlich Laboratories, Inc:** formerly Raymond C Crippen Research and Development Laboratories, Baltimore, Md. **ACF Industries, Inc:** American Car & Foundry Co, 30 Church St, New York, N. Y.

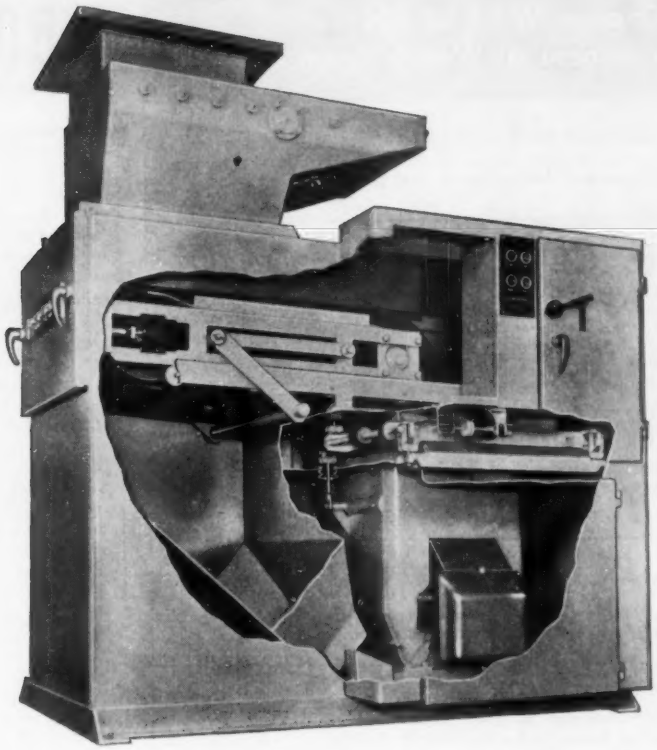
Institute elections

Purchasing Agents Association of New York: Stanley W MacKenzie, president. **American Boiler Manufacturers Association:** William P Heuser, president. **Industrial Unit Heater Association:** James W Hosler, vice-president. **Illuminating Engineering Society:** Marshall N Waterman, vice-president.

Air Pollution Control Association: Gordon P Larson, president. **National Association of Power Engineers:** William J Strickler, president. **Power Fan Manufacturer's Association:** C Espy Reed, president; John F. Snow, 1st vice-president; E C Englert, 2nd vice-president. **Metal Powder Association:** Paul E Weingart, president. **American Public Power Association:** William S Peterson, executive vice-president.

Obituaries

Charles S Davis, 77, chairman of board and formerly president of **Borg-Warner Corp, July 2. Walter J Welch,** 77, retired chief design engineer for Pioneer Service and Engineering Co, July 13.



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Write for Coal Scale Bulletin No. 61 or for our local representative to call and discuss the application of the S-E-Co. Coal Scale and related equipment to your particular plant problem.

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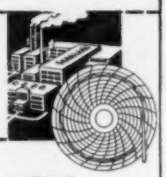

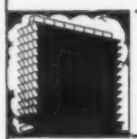

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Prevents corrosion and protects tanks and equipment in refrigerating brine and sweet water systems.

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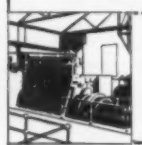
Stops corrosion and scaling in hot water supply tanks and lines, maintaining service without impairing potability.



6 WESTERN LIGHTNING TREATMENT

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Elements of Electrical Engineering. *(Sixth Edition). By Arthur L Cook, formerly Director, School of Science & Technology, Pratt Institute and Clifford C Carr, Chairman of Curriculum and Head of Department of Electrical Engineering, Pratt Institute. 6 x 9, 682 pp, $6.75. John Wiley & Sons, Inc of New York and Chapman & Hall, Ltd of London.*

Successive revisions of this book have kept it abreast of the field, but the authors have never lost sight of the original objective—a clear presentation of principles in a manner that brings out physical significance of relations and does not depend merely upon mathematical derivations and formulas.

The new edition is notable for its emphasis on basic principles. While text is not burdened with unnecessary detail, it avoids oversimplification and accompanying dangers of inaccuracy.

Many of the changes in this edition are based on a nationwide survey undertaken to find in what ways usefulness of the book could be increased. While basic arrangement is generally unchanged, latest edition represents a thorough revision—more than half the book has been completely rewritten.

Material is so flexibly arranged that its sequence can be altered to meet needs of special courses. In the preface, the authors indicate some possible sequences.

Best's Safety & Maintenance Directory. *(Fifth Edition). 8 x 11, 582 pp, Bound in gold fabrikois, $5.00, Alfred M Best Co Inc, 75 Fulton St, New York 38, N. Y.*

This directory lists, describes, analyzes and illustrates all essential safety and maintenance products and equipment on the market. It shows what to use and when, who makes it and where to buy it. New features include sections on structural materials, highway transportation safety and noise measurement and control.

Broken down into 12 basic sections, the book covers: fire protection equipment, protective clothing, personal hygiene and first aid, plant maintenance, ladders, and scaffolding, atmosphere control, machinery guarding and maintenance, handling equipment, working aids, training aids and building materials.

Applied Electronics *(Second edition). By Truman S Gray, Associate Professor of Engineering Electronics, Massachusetts Institute of Technology, 6 x 9, 881 pp, $9.00. John Wiley & Sons, Inc, 440 4th Ave, New York 16, N. Y.*

For practicing engineers and electrical engineering students, this text presents an understandable discussion beginning with elementary facts and principles. For those who already have a basic knowledge of electronics, its foundational treatment and practical illustrations and problems will provide a useful means for further study and reference.

First part of this book is devoted to a discussion of physical phenomena, really the foundation of electronics. This is followed

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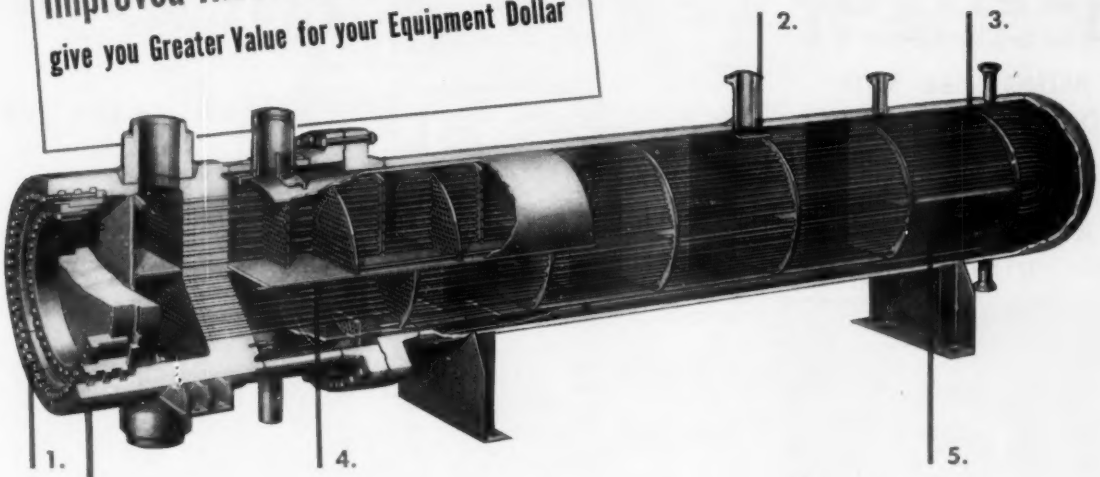

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More BOOKSHELF

Begins on page 242

by an explanation of the way phenomena combine to govern characteristics, ratings and limitations of electronic devices. Final chapters provide information on applications of electronics in various branches of electrical engineering.

Power men interested in electronic fundamentals will benefit particularly from chapters on gaseous rectifiers, semiconductors and transistors.

"Timing" Belt Drive Engineering Handbook (*1954*). *By Richard Y Case. 5½ x 8½, 189 pp, illust, cloth. Information on availability from C R Weimer, US Rubber Co, Rockefeller Center, New York 20, N. Y.*

This handbook provides pertinent engineering data to enable a designer to incorporate "timing" belt drives in new or redesigned machinery or equipment. Belts and pulleys in stock sizes can be selected for experimental or production use from the standard drive tables included in the book.

Besides describing the timing belt and pulley design, and explaining the calculations necessary for belt length and width, the book incorporates a chapter on representative applications. These fall into three classifications: (1) transmitting power (2) synchronizing two or more shafts (3) acting as a conveyor or other functional machine part.

The applications described include drives for pumps, blowers, centrifuges, textile looms, motorized hand tools.

Practical Piping Flexibility—Design and Flow (*1953*). *By W A Thomas, consulting engineer. 200 pp. 6 x 9. Loose-leaf ring binder. 154 illus. 72 tables, 31 charts. $25.00. W A Thomas, 2742 Philadelphia Ave, Pittsburgh 16, Pa.*

Thermal stress and reactions in piping systems are explored thoroughly by the author. He gives a new method for rapidly checking by charts and graphs the maximum thermal stress and reactions in piping arrangements between two anchors. By use of this method, it is reported that two days' work in mathematical calculations can be done in two minutes.

Included in the volume are charts, formulas and tables covering flow of water, steam up to critical pressures and viscous liquids. Pipes from one to 24 inches inclusive are dealt with in the tables.

Lubrication of Industrial and Marine Machinery (*Second Edition*). *By the late William Gordon Forbes, revised by C L Pope and W T Everitt, both with Eastman Kodak Co. 351 pp, 6 x 9, $6.50. John Wiley & Sons, Inc, 440 4th Ave, New York 16, N. Y.*

This is a practical book for engineers concerned with everyday problems of plant lubrication. It fills a need in a field where there is little available in the way of simply-written books dealing with the aspects of lubrication of concern to plant men. The authors have provided a manual clearly explaining fundamental characteristics of conventional lubricants and analyzing some

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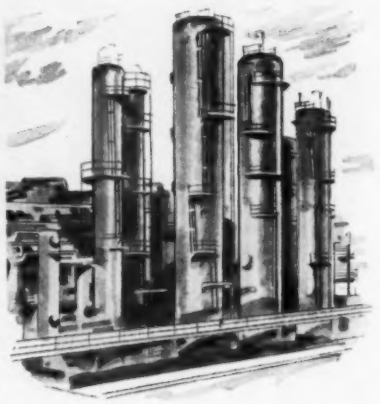

While this leak-detecting device carries a $49,000,000.00 price tag, it is worth every penny of it! This device will not find leaks any faster than lower-priced models, but it will usually find more of them.

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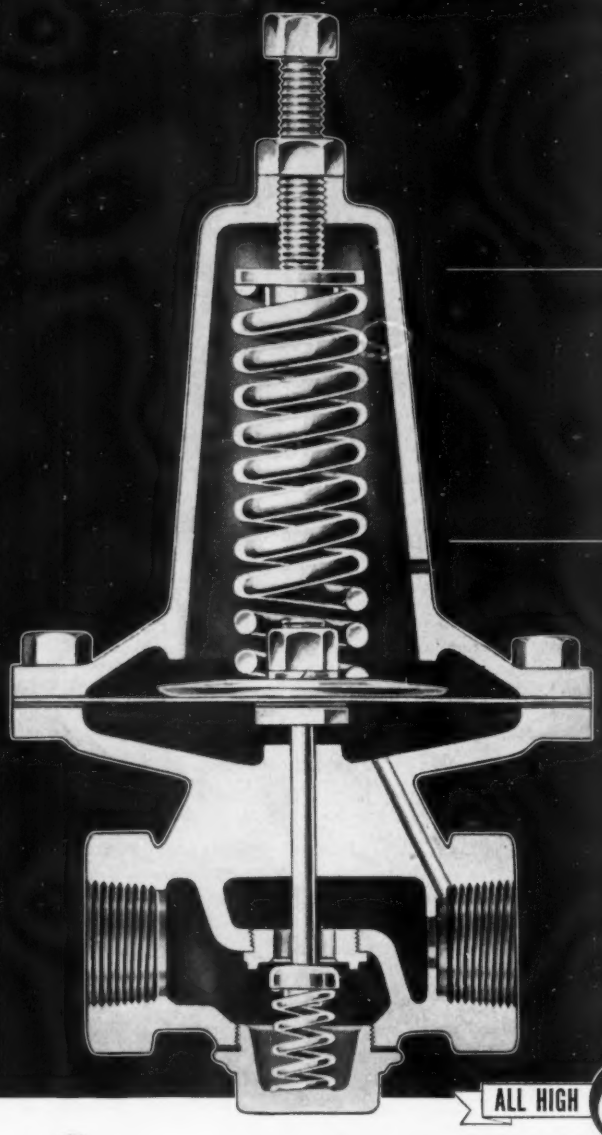
STAINLESS STEEL • MONEL

CRAWFORD FITTING CO.
884 E. 140th Street
Cleveland 10, Ohio

MASONEILAN No. 33

FOR SMALL

STEAM LINES



Takes the SHAKES Out of Pressures

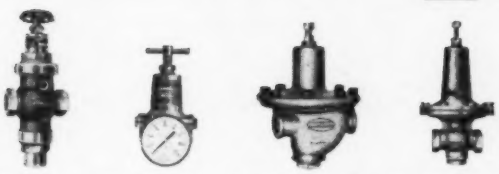
Here's an accurate, tight-closing reducing valve for small steam or air systems. Designed for a wide range of adjustment, Masoneilan No. 33 is a versatile, dependable way to keep line pressures constant.

Simplifies Maintenance

Easy to install, adjust and service, Masoneilan No. 33 reduces maintenance to a minimum. Stainless steel valve plug and seat ring assure long life. All parts are removable with valve in the line.

Available for initial pressures up to 200 lbs., reduced to any pressure from 2-20 lbs., 20-60 lbs., 60-100 lbs. Sizes ¼" to ¾". For more information write Mason-Neilan Regulator Company, 1186 Adams Street, Boston 24, Mass. . . . or see your local industrial distributor.

ALL HIGH Cq (Quality Coefficient) PRODUCTS



No. 11 for steam No. 21 for air No. 227 for water No. 33 for steam, air

MASONEILAN REGULATORS

Keep Pressure Under Control!

"GET THIS STRAIGHT!"

All I want is an opportunity to prove that Enos and Enoco coals can do the job better.

A-8990

Place a trial order • Make a test comparison

THE ENOS COAL MINING COMPANY

Sales Offices for Enos and Enoco Coals

1405 Merchants Bank Bldg. • Indianapolis 4, Indiana

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Reach any Overhead Valve From the Floor with...

Babbitt

Adjustable

SPROCKET RIM

with Chain Guide

Get positive, efficient control of any overhead valve right from the floor! No expensive apparatus, no switches, no costly detours to bring overhead piping to floor level — because every valve is within easy reach, when you use low-cost Babbitt Adjustable Sprocket Rim with Chain Guide. Easily assembled and installed, ready to operate in a few minutes.

- Safe, sane & sensible
- Cuts piping costs
- Saves fuel & steam

Range of 10 adjustable sizes fits all valve wheels from 2 to 30 inches diameter, with rising or non-rising stems. Only four simple, quickly-assembled parts.

Call your Industrial Distributor. He carries complete stocks. Or write for descriptive folder and prices.

Babbitt STEAM SPECIALTY CO.

More BOOKSHELF

Begins on page 242

of the more basic mechanisms: bearings, gears, pumps, compressors, etc.

The first chapters sketch basic chemistry for different oils, greases and graphites and provide a comprehensive explanation of their methods of refinement. Specifications and measurements are discussed in detail and the characteristics of individual lubricants are covered. Chapters 15-32 explain lubrication requirements of the most common types of machinery. The concluding chapters provide practical application.

Metals and How to We'd Them *(1954) By T B Jefferson, Editor, The Welding Engineer, and Gorham Woods, Metallurgist. 322 pp, 6 x 9, 170 drawings, photos and tables; stiff board, cloth covered binding, $2.00. The James F Lincoln Arc Welding Foundation, Cleveland 17, Ohio.*

This book is a combination text and reference book to give all users of welding a practical work knowledge and source of information for designing and making better welds at lower cost. Two men of wide welding experience and writing ability have created this book especially for the student, welding operator, supervisor, instructor, engineer, designer and manager. It is organized and written to explain in clear, logical, readily understood steps, the structure and properties of metals and how to weld them.

First six chapters are on elementary discussion of metals, their mechanical and physical properties and uses. Fundamentals of metallurgy and their significance in heat treating and welding are explained in logical steps. This information is then related to correct welding procedures for steels, cast iron, nonferrous materials and hardfacing. All commonly used types of metals are covered.

Final section of book tells how to make good welds, shoot trouble, estimate cost and explains welding terms.

Keystone Coal Buyers Manual *(1954). Directory material, maps of U.S. coal fields, thumb indexed. 726 pp. 8½ x 11. Hard cover. $25.00. McGraw-Hill Publishing Co, 330 W 42nd St, New York 36, N. Y.*

Contains literally thousands of facts concerning the production, marketing and problems of the coal industry. Includes sections on equipment, mines, their locations, size, type of opening, seam and thickness, number of employes and production.

Transportation, coke ovens and export piers are also detailed in this volume, which has been referred to as the "Coal Man's Bible" because of its completeness and authenticity, according to the publishers.

New transformer designed for use at General Electric Co's switchgear development laboratory in Philadelphia is 33 ft high, weighs 50,000 lb, and has 50 miles of copper wire and more than 3000 lb of insulation in its innards. Said to be the world's largest and highest-rated potential transformer, it was built to step down the ultra high voltage used for testing large circuit breakers to study their behavior.

a ship load of wonderful Marmaduke stories and only $1

Here are 21 of Marmy's most fabulous engineering exploits, exactly as they appeared in the pages of POWER. Generously illustrated and bound in varnished red cover. It's a collection any engineer will want to read and re-read. Only one dollar, postpaid. Supply is limited, order today.

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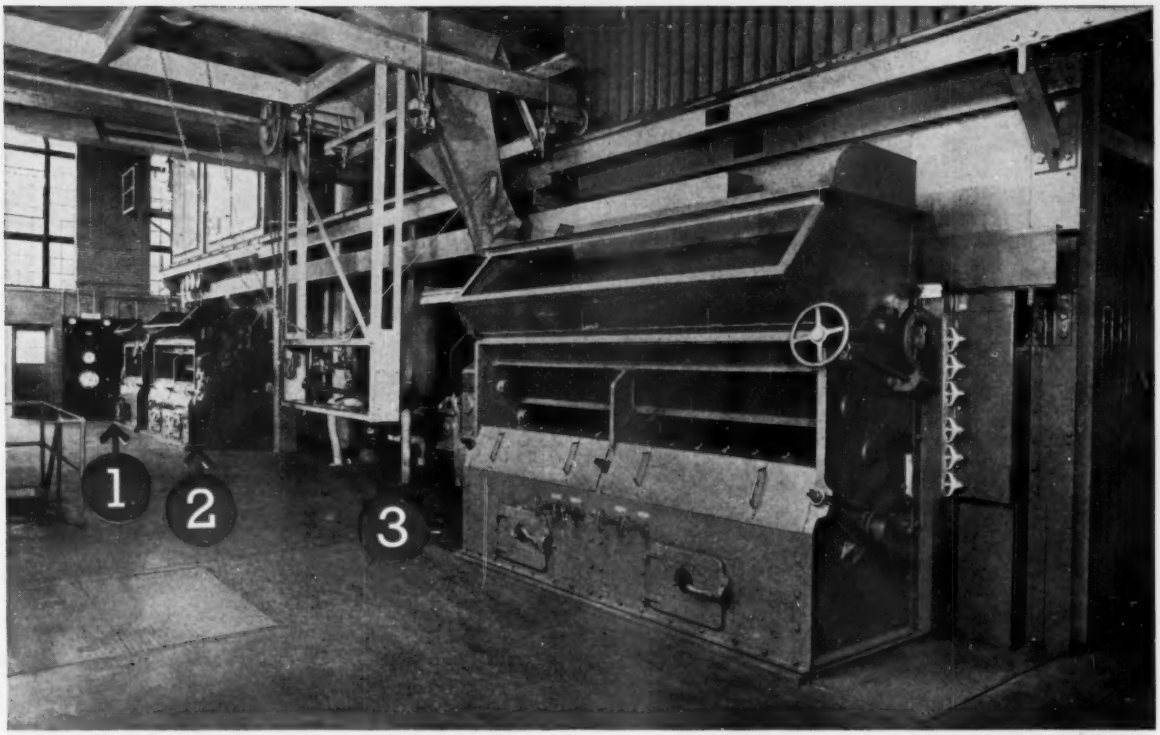


first there was 1 ... then 2 ... and now 3

Stowe's proven performance wins repeat orders

● The first Stowe Stoker installed at the University of Detroit was a small 300 H.P. unit. It replaced a multi-retort stoker — immediately increased boiler output from 150% to 225% of rating — relieved the University of buying high priced premium coal — and carried the entire heating load (except during the most severe weather) for an entire heating year.

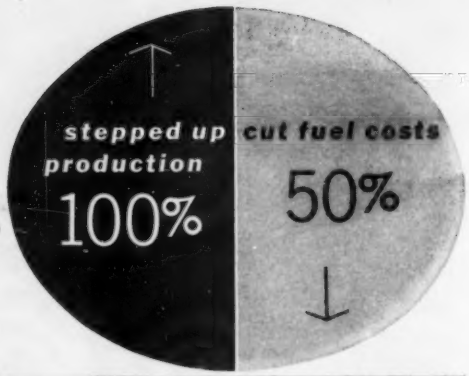
Based on this outstanding performance, the University's 500 H.P. boiler was re-stokered with a Stowe in 1946. Again boiler output was increased 50%. Together these two Stowes saved $9,000 per year just in coal costs, while giving 50% more steam output. The third Stowe, installed under a new boiler in 1952, carries the increased load resulting from the University's extensive new building program.

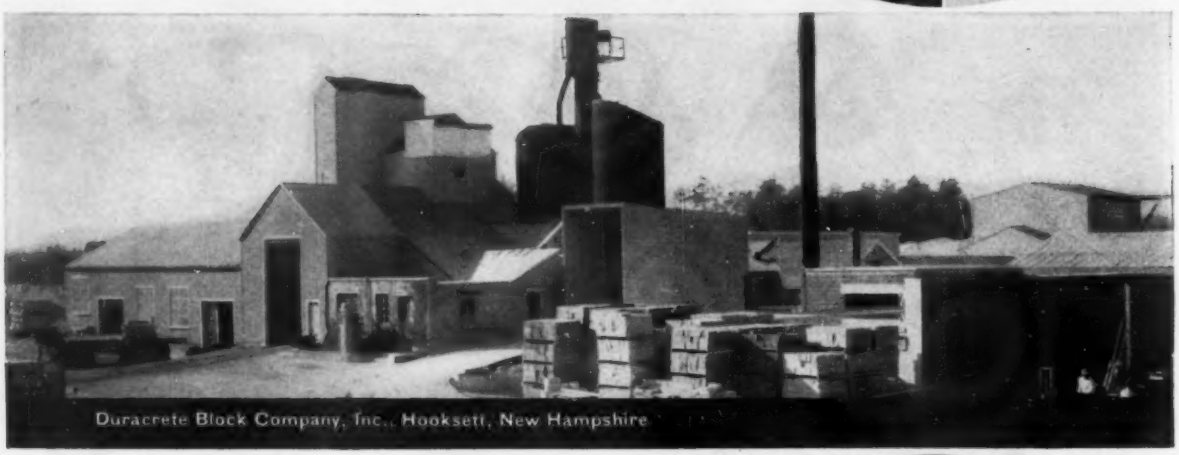
For high steam output — low fuel costs — and efficient operation so free from smoke and fly ash nuisance that the stack can be used as a beautiful monumental tower — get a Stowe! They're best for any load.

"More Power to You" with **STOWE Stokers**

Manufactured by THE JOHNSTON & JENNINGS CO. • 6917 Bessemer Avenue • Cleveland 27, Ohio
.... *Division of* PETTIBONE MULLIKEN CORP...

How a KEWANEE Reserve Plus Rated boiler...




Duracrete Block Company, Inc., Hooksett, New Hampshire

■ Anyone would find it difficult to prove to Dante V. Donati, Manchester, New Hampshire, that Kewanee Reserve Plus Rated Boilers do not pay dividends. That's because he discovered it the hard way. First, he bought an ordinary boiler for his plant at the Duracrete Block Company. He operated it one year, and then . . . but let him tell the story—

"We installed an ordinary boiler and found it to be inadequate. We then purchased a Kewanee Unit. Our production was stepped up more than 100% . . . with fuel costs cut in half. Maintenance cost is extremely low. The quality of our product has improved because of lower moisture content due to ample steam for processing."

Judging from Mr. Donati's experience it just makes sense that it's money in the bank to follow the Kewanee Reserve Plus Rating Plan in selecting a boiler. So when you choose a boiler, know these important facts:

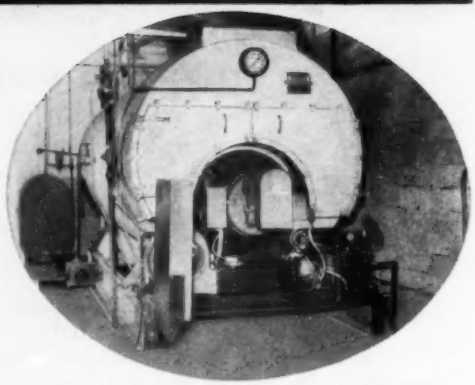
1—*Boiler rating must be based on nominal capacity, not maximum capacity;*

2—*Boilers must have sufficient built-in reserve to meet changing demands;*

3—*Boilers must have sufficient capacity to operate at "cruising speed," not maximum speed at all times;*

4—*Like examples must be considered in comparing boilers. Don't be confused by vague technical claims.*

Choose Kewanee and cut fuel costs—lower maintenance—reduce breakdowns—get longer boiler life.



Here is No. 85-60 Kewanee Oil Fired Boiler-Burner Unit installed at the Duracrete Block Company.

KEWANEE BOILERS

KEWANEE-ROSS CORPORATION, Kewanee, Illinois

Division of American Radiator & Standard Sanitary Corporation

Serving home and industry · American-Standard · American Blower · Church Seats & Wall Tile · Detroit Controls · Kewanee Boilers · Ross Exchangers · Sunbeam Air Conditioners

YOU can depend on KEWANEE engineering

EASY TO SERVICE...

a plus value of ASHCROFT

Maxisafe DURAGAUGES

Turn the knob on the back of the *Maxisafe* and the plate comes off, fully exposing the entire mechanism for fast and easy inspection, recalibration or adjustment. This time and money-saving feature is highly favored wherever Ashcroft *Maxisafe* Duragauges are in service.

This Duragauge was named *Maxisafe* because it has an integrally-cast wall to separate the dial from the movement and Bourdon Tube assembly — a solid wall of safety that protects the viewer if the tube ever ruptures. Covering the back of the case is a double spring mounted safety release plate — a Teflon-coated plate tightly fitted on a rubber gasket and held in place by a knurled knob. Less than 0.5 psi pressure created by a ruptured tube forces this cover open — vents the discharge safely to the rear.

The Maxisafe is available in 4½", 6" and 8½" dial sizes. You can have a choice of standard Ashcroft Duragauge pressure ranges, case designs (except Types 1179 and 1279), and mountings. Get the utmost in sustained accuracy, durability, protection and convenient servicing. Specify Ashcroft *Maxisafe* Duragauges.

YOUR INDUSTRIAL SUPPLY DISTRIBUTOR has complete facts about Ashcroft Gauges of all types. You can depend on his knowledge and experience to help you satisfy every requirement of the application. He maintains local stocks to serve you promptly and economically.

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ASHCROFT GAUGES

A product of **MANNING, MAXWELL & MOORE, INC.** STRATFORD, CONNECTICUT

MAKERS OF 'ASHCROFT' GAUGES, 'AMERICAN' AND 'AMERICAN-MICROSEN' INDUSTRIAL INSTRUMENTS, 'HANCOCK' VALVES, 'CONSOLIDATED' SAFETY AND RELIEF VALVES, AIRCRAFT PRODUCTS. BUILDERS OF "SHAW-BOX" AND 'LOAD LIFTER' CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES.

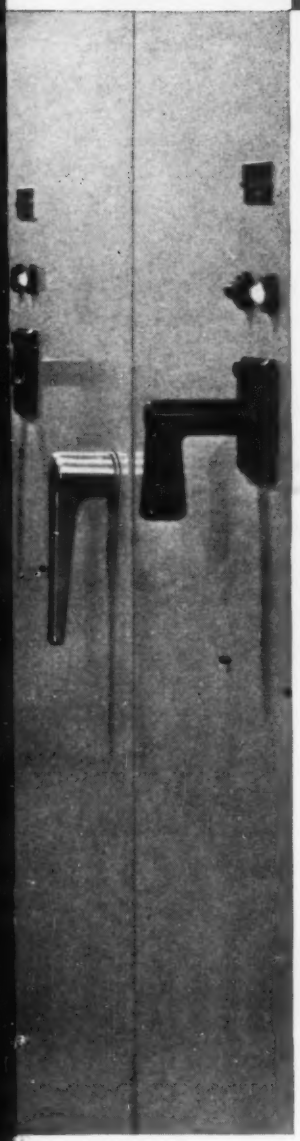
1951 GENERAL ELECTRIC INTRODUCES SELF-X, A NEW FLAME-RETARDANT INSULATION

1954 SELF-X GUARDS OVER 10,000 GENERAL ELECTRIC METAL-CLAD UNITS

G-E METAL-CLAD SWITCHGEAR lineup features Self-X, G.E.'s service-proved flame-retardant insulation, at vital points.

COFFIN AWARD. Nicholas F. Arone, laboratory engineer in G-E Switchgear Product Laboratory, receives Company's highest employee honor—the coveted Coffin Award—from G. E. Burens, General Manager, Switchgear and Control Division, for developing Self-X insulation.

COMPARISON TEST shows why Self-X insulation gives better protection to metal-clad switchgear. In this photograph, taken immediately after both pieces of insulation were withdrawn from the flame, N. F. Arone (at right) holds a piece of ordinary insulation which continues to burn, while the Self-X held by H. F. Hentschel, General Manager—Medium Voltage Switchgear Department, stopped burning as soon as flame was removed. Other tests of Self-X included exposure to electric arc.



Self-X insulation proved by three years of service

Back in 1951, the first sheets of a new type of flame-retardant, self-extinguishing insulation, just developed by General Electric, were installed in a metal-clad switchgear unit.

In severe laboratory tests, the new Self-X insulation proved that it could stand up even under direct flame or an electric arc. As soon as direct flame contact was removed, polyvinylchlorides in the laminated sheets went to work *fast*. Smothering action started—and the fire was put out in less than a minute.

That was over three years ago. Today, this service-tested insulation developed by General Electric Company is acting as a built-in fire extinguisher for over 10,000 switchgear units. Its flame-retardant features make it ideal for bus and cable supports, insulating barriers, between compartments, box carriers for arc chutes—all vital spots.

Self-extinguishing insulation is just one of the advanced safety features of G-E Metal-Clad Switchgear, which helps guard utility and industrial power distribution systems. To learn more about it, call your nearest G-E Apparatus Sales Office or Authorized Agent. Or write for bulletin GEA-5664 to General Electric Company, Schenectady 5, N. Y.

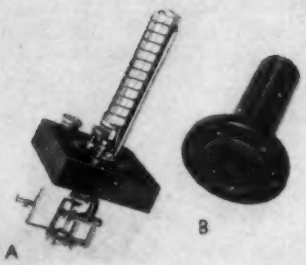
511-4

Progress is our most important product

GENERAL ELECTRIC

Accurate Measurement of

HIGH DIFFERENTIAL PRESSURES



Heart of the Foxboro Type EH Differential Pressure Controller (below) is the heavy-duty stainless steel helical measuring element (A) with its alloy-steel housing (B). This assembly is mounted at rear of instrument case, the motion of the helical being transmitted to the instrument mechanism through a friction-free pressure seal bearing.

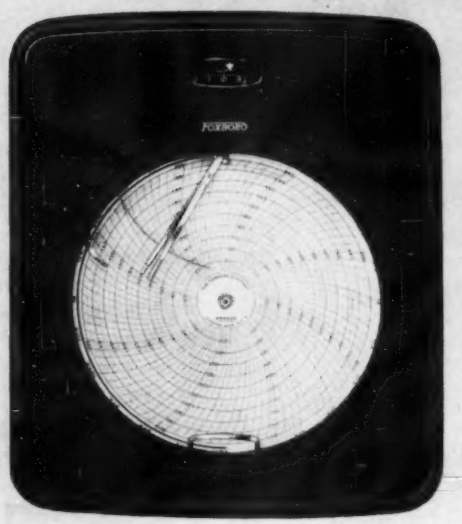
...at high statics!

Differential pressure measurements at ranges far above the limits of conventional devices, and at statics up to 2200 psig, can be readily recorded and controlled by the new Foxboro Type EH Instrument.

Many large steam generating plants have installed Type EH Instruments to control differential pressure across boiler feed valves, thus assuring at all times that the boiler feed pump is operating at pressures high enough above boiler pressure to assure safe operation.

Major chemical companies have employed this instrument to measure pressure loss across fixed catalyst beds. By operating until a pre-determined pressure loss indicates catalyst exhaustion, instead of shutting down and regenerating on a time cycle, they have increased production, cut costs.

Differential pressure ranges are available from 0-100 psig minimum to 0-2200 psig maximum. Design of the helical actuating element assures precision over the entire measuring span. Heavy-duty construction of the element and its housing makes operation safe.



Write for Technical Data Sheet on Foxboro Type EH Instruments for indicating, recording, controlling, transmitting.

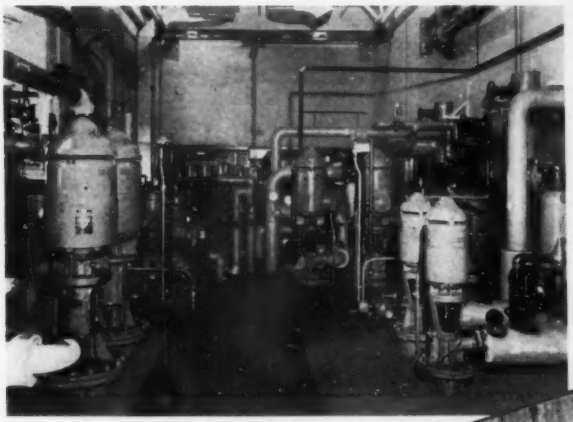
THE FOXBORO COMPANY, 689 NEPONSET AVE., FOXBORO, MASS., U. S. A.

FOXBORO
REG. U. S. PAT. OFF.

PRESSURE INSTRUMENTS

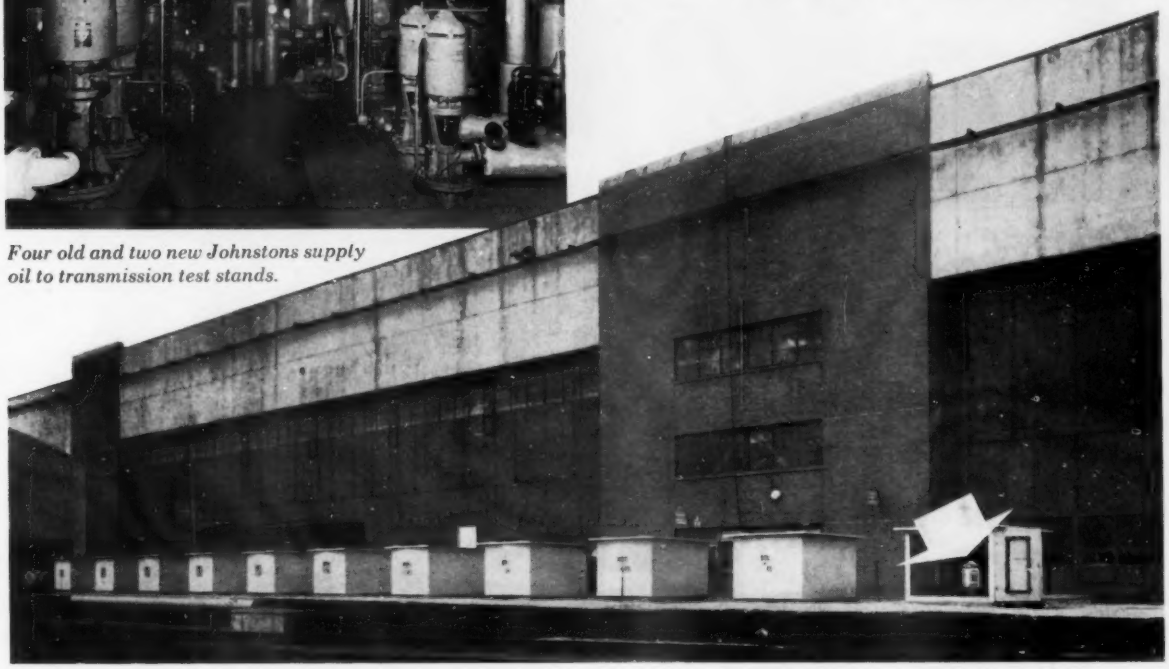
FACTORIES IN THE UNITED STATES, CANADA, AND ENGLAND

You can't beat a Johnston Dealer for pump know-how...



Four old and two new Johnstons supply oil to transmission test stands.

That's why this big automobile plant uses JOHNSTON PUMPS!



Eleven Johnstons are installed over storage tanks, operating automatically as fluid is needed in plant.

JOHNSTON VERTICAL PUMPS

Kerr Machinery Company is the Johnston Pump Dealer in Detroit, Michigan. When the Livonia, Michigan plant of Detroit Transmission Division, General Motors Corporation was destroyed by fire, pumps had to be delivered *in a hurry* to the new plant at Ypsilanti, Michigan. Detroit Transmission called on Kerr for 15 close-coupled vertical turbine pumps to handle cutting oil, hydraulic oils, solvent, lubricating oils and rust inhibitors. Kerr worked with Detroit Transmission engineers on the specifications for the pumps and phoned the order to Johnston's factory in Pasadena, California... and Johnston delivered by chartered plane – ON TIME!

Four Johnston Pumps, which survived the Livonia fire, are now operating at the new plant, circulating oil to all the test stands for lubricating and flushing the transmissions, and for functional hydraulic tests. From the test stands, the oil is then returned to an underground storage tank.

Of prime consideration in selection of Johnston Pumps were the advanced safety features and the fact that *Johnstons are always ready to go without priming.*

Detroit Transmission has been so satisfied with the products and service of the Kerr-Johnston Team that they have recently placed another order for six more pumps that will be used for handling gasoline and diesel fuel.

For the kind of know-how provided by Kerr Machinery Company on this job, see your nearby Johnston Dealer. He's always glad to help.

JOHNSTON PUMP COMPANY
3272 East Foothill Blvd.

Mailing Address: Bin "K," Pasadena 15, Calif.

☐ ***Please have your representative call.***
☐ ***Send your Bulletin G-94.***

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Address _____

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SLEEVOIL

—the super-quality fan bearing for mechanized draft installations!

● Hundreds of generating plants in America run on Dodge Sleevoil Bearings. These famous bearings combine quietness, long life and dependability to a degree unique in the bearing field. They offer engineers of costly power plants a priceless safeguard for their equipment.

Sleevoil Bearings are a Dodge development—created especially to meet the exacting requirements of fan and blower service. They are ideal bearings for important installations calling for induced or forced draft. Designed in cooperation with engineers of leading fan and blower manufacturers, they have a long record of dependable performance in critical service.

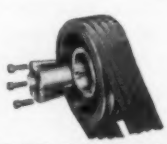
Dodge Sleevoil Pillow Blocks are normally available from stock—in both plain and water-cooled types, in shaft sizes from 1-7/16" to 8". Write us for information.

DODGE MANUFACTURING CORPORATION
3200 Union Street, Mishawaka, Indiana

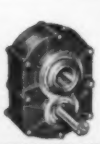
DODGE
of Mishawaka, Ind.

CALL THE TRANSMISSIONEER, your local Dodge Distributor. Factory trained by Dodge, he can give you valuable assistance on *modern* power transmission machinery for *modern* installations. Look for his name under "Power Transmission Equipment" in your local classified phone book.

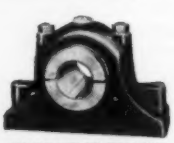
FIRST IN POWER TRANSMISSION MACHINERY!



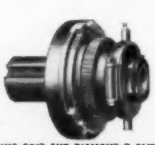
SEALED-LIFE V-BELTS; TAPER-LOCK SHEAVES



TORQUE-ARM SPEED REDUCERS



DODGE-TIMKEN PILLOW BLOCKS



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FOR YOUR NAME PLATE REQUIREMENTS, WRITE OUR SUBSIDIARY,
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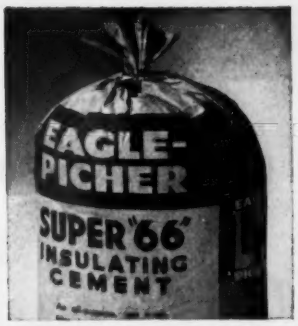
EAGLE-PICHER

Super "66" Insulating Cement



Conforms to Commercial Standard CS-117

Because Eagle-Picher Super "66" Insulating Cement *really sticks*, it has money-saving advantages that are apparent the minute your crew begins to apply it.

Because *it sticks*—less time is wasted in application—it stays where you put it whether the equipment is heated or temporarily out of service. It "holds together" — usually no reinforcing needed on applications up to 1½ inches thick.

Because *it sticks*—Super "66" can be used effectively, economically on all types of surfaces—flat, curved, overhead—anywhere you need insulation. It's truly an all-purpose cement.

And—Super "66" is rust-inhibitive—cannot cause corrosion–actually helps prevent corrosion of costly equipment.

If you've never tried Eagle-Picher Super "66," it will pay you to learn more about it today!

"Springy Ball" structure—*the secret of the high thermal efficiency of Super "66." These small, resilient pellets of mineral wool, each one honeycombed with thousands of minute air cells, effectively resist the flow of heat even when used on equipment heated to 1800 F.*

Since 1843

EAGLE EP PICHER

THE EAGLE-PICHER COMPANY

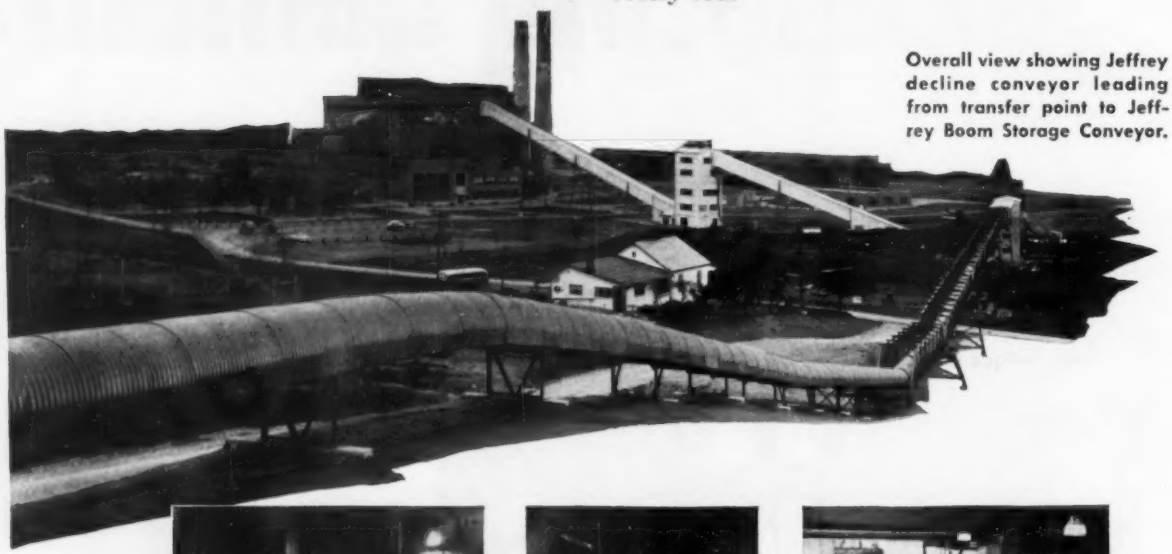
General Offices: Cincinnati (1), Ohio

For greater efficiency, protection and economy, you should investigate these Eagle-Picher products: Insulating Felts • Insulating Block • Blankets • Loose Wool • Mineral Wool Pipe Covering • Stalastic Stamastic • Insulseal • Finishing Cements • Insulating Cements • Swetchek • Insul-Stic • Fireproofing Cement

Member of Industrial Mineral Fibre Institute

long haul economy through JEFFREY engineering

Columbus and Southern Ohio Electric Company assigned Jeffrey the problem of drawing coal 6,739 feet from a mine area to its Poston station. Careful engineering produced what is believed to be the longest incline-decline 24" belt conveying system in the country. It carries 300 TONS AN HOUR . . . 570 FEET PER MINUTE. Jeffrey equipment, at both ends of the line and at the transfer point, weighs, crushes and keeps the big Poston bunkers continuously and correctly fed.



Overall view showing Jeffrey decline conveyor leading from transfer point to Jeffrey Boom Storage Conveyor.

Two Jeffrey-Traylor Vibrating Feeders at hopper bottom.

Jeffrey Crusher for reducing oversize coal to the desired stoker size.

Incline belt in gallery to Poston bunkers.

THE JEFFREY MANUFACTURING CO.

ESTABLISHED 1877

Columbus 16, Ohio

sales offices and distributors in principal cities

PLANTS IN CANADA, ENGLAND, SOUTH AFRICA

IF IT'S MINED, PROCESSED OR MOVED

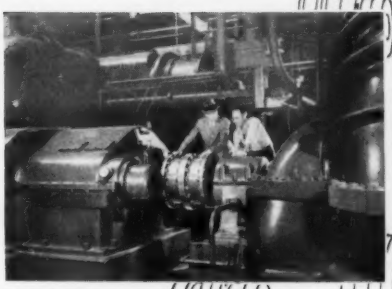
. . .IT'S A JOB FOR JEFFREY!

See why
FAST'S Couplings
are your wisest buy

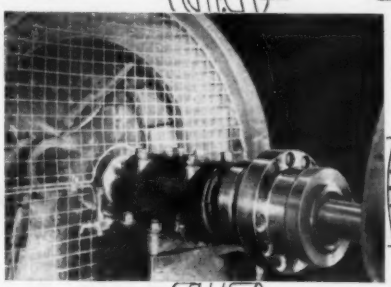
LESS DOWN-TIME. Industry finds that Fast's Couplings, the original gear type coupling, give trouble-free performance. They save on maintenance. Save money (often thousands of dollars in production losses) year in, year out, because there is no down-time due to breakage . . . no expense of replacing perishable parts.

LOWEST COST PER YEAR because Fast's Couplings usually outlast the equipment they connect. Many Fast's Couplings are still in use after 30 years. Why? Because they are ruggedly constructed of the sturdiest, most practical materials . . . all steel in construction, unique in design.

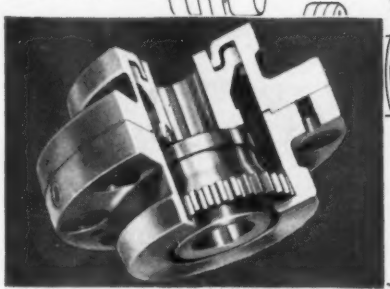
FREE ENGINEERING SERVICE. The same "Know-how" that goes into the manufacture of famous Fast's Couplings . . . that has resulted in over three-fourths of a million successful installations . . . applies to its extensive engineering service. 35 years of experience in developing the most satisfactory materials and designs, means our staff is well prepared to give you the most effective and cost-saving solutions to your coupling problems. Just outline and send them to Koppers for assistance. And send for free catalog. Just mail the coupon below.



Fast's Coupling installation in a modern power plant.



Close-up of Fast's Coupling, linking power to industrial fan.



Cutaway view of typical Fast's Coupling. Note unique design.

THE ORIGINAL

FAST'S Couplings

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METAL PRODUCTS DIVISION • KOPPERS COMPANY, INC. • BALTIMORE, MD. This Koppers Division also supplies industry with American Hammered Industrial Piston and Sealing Rings, Koppers Electrostatic Precipitators, Aeromaster Fans and Gas Apparatus.

Engineered Products Sold with *Service*

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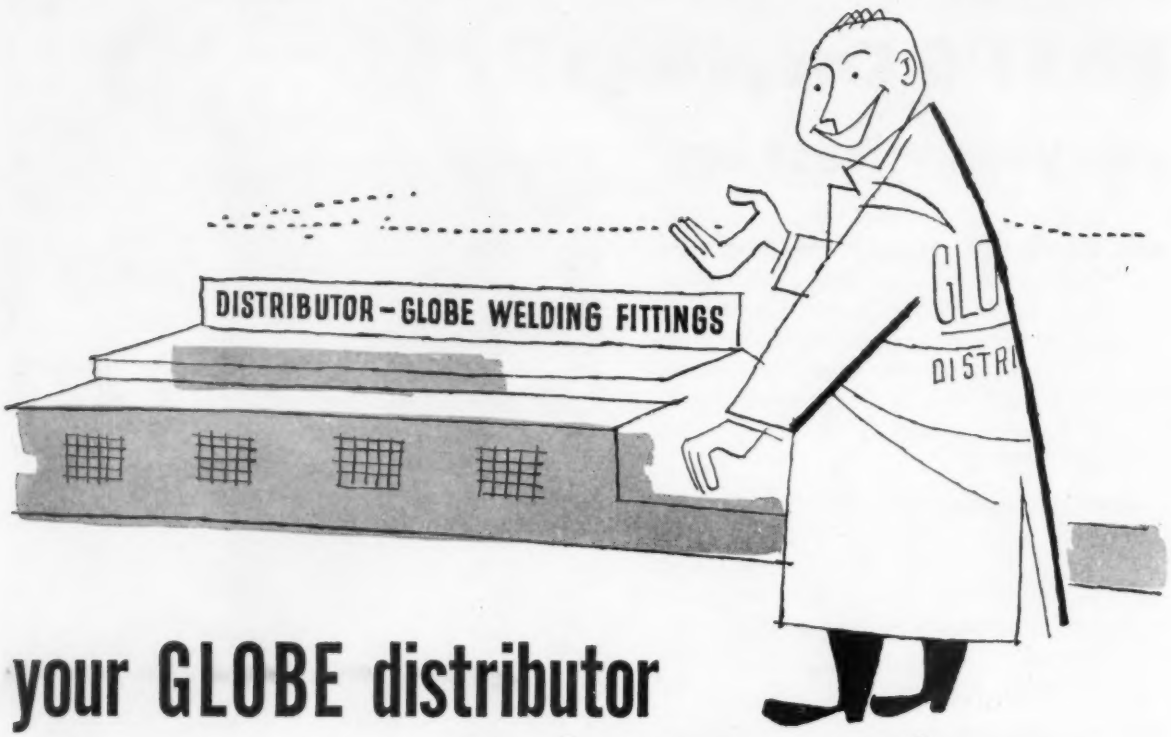

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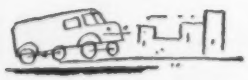

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GLOBE
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SEAMLESS WELDING FITTINGS

GLOBE TUBES

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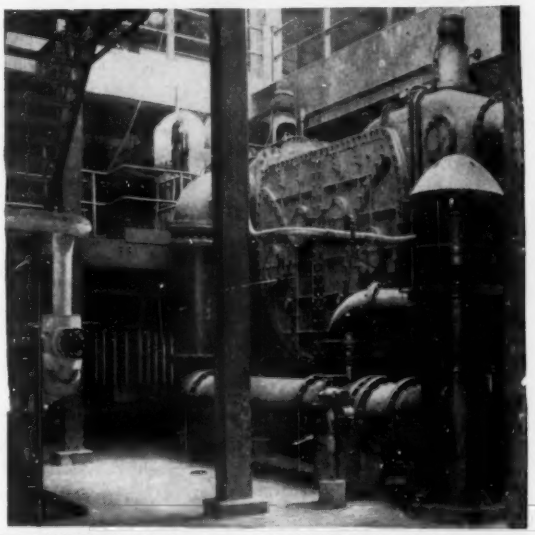
NOTES

for the engineer's note book

. . . ON
WHEELER-ECONOMY
POWER PLANT
EQUIPMENT

NO SHUTDOWN, NO LOAD REDUCTION, NO HAND CLEANING . . . WITH C. H. WHEELER *REVERSE FLOW* CONDENSERS

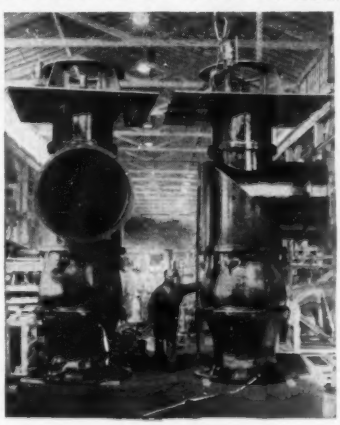
The savings in dollars and downtime effected by C. H. Wheeler's Reverse Flow design for steam condensers are a matter of record in public utilities and private power plants throughout the country. Chances are, you can inspect a nearby installation and learn first hand how efficiently debris of vegetable, animal and mineral matter is dislodged from the tube sheet and flushed away by reversing the flow of the cooling water through the Condenser. Cleaning work that formerly took hours is accomplished in minutes with no interruption in load. C. H. Wheeler custom-engineers your steam condensing hook-up to pay off in long range sustained efficiency. (Bulletins mailed on request.)



WHEELER - ECONOMY CIRCULATORS

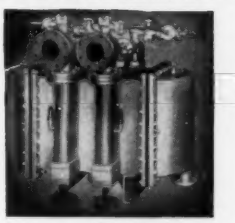
Lasting Dependability
Minimum Maintenance

Wheeler-Economy Circulators include: mix-flow vertical wet pit type with both standard and pull-out design; vertical mix-flow volute type for dry pit installations; and horizontal single stage centrifugal constructions to 100,000 GPM capacities. Wheeler-Economy pumps for general service include: single stage high head double suction; multi-stage with horizontal or vertical split case; pumps for sump, process and fire protection services. Wheeler-Economy also invites your special problems requiring custom design. (Bulletins mailed on request.)



TUBEJET AIR EJECTORS

Steel Shell
More Reliable



C. H. Wheeler Steel Shell Tubejet Air Ejectors provide worthwhile savings in space and weight. They are available with either single or multiple element, two-stage type with combined surface inter-after condenser. Write for Bulletin.

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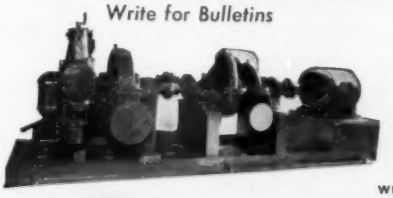

WE-400

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C. H. WHEELER MANUFACTURING CO., 19th & LEHIGH, PHILADELPHIA 32, PENNA.

Steam Condensers • Centrifugal, Axial and Mixed Flow Pumps • Steam Jet Ejectors • Vacuum Refrigeration
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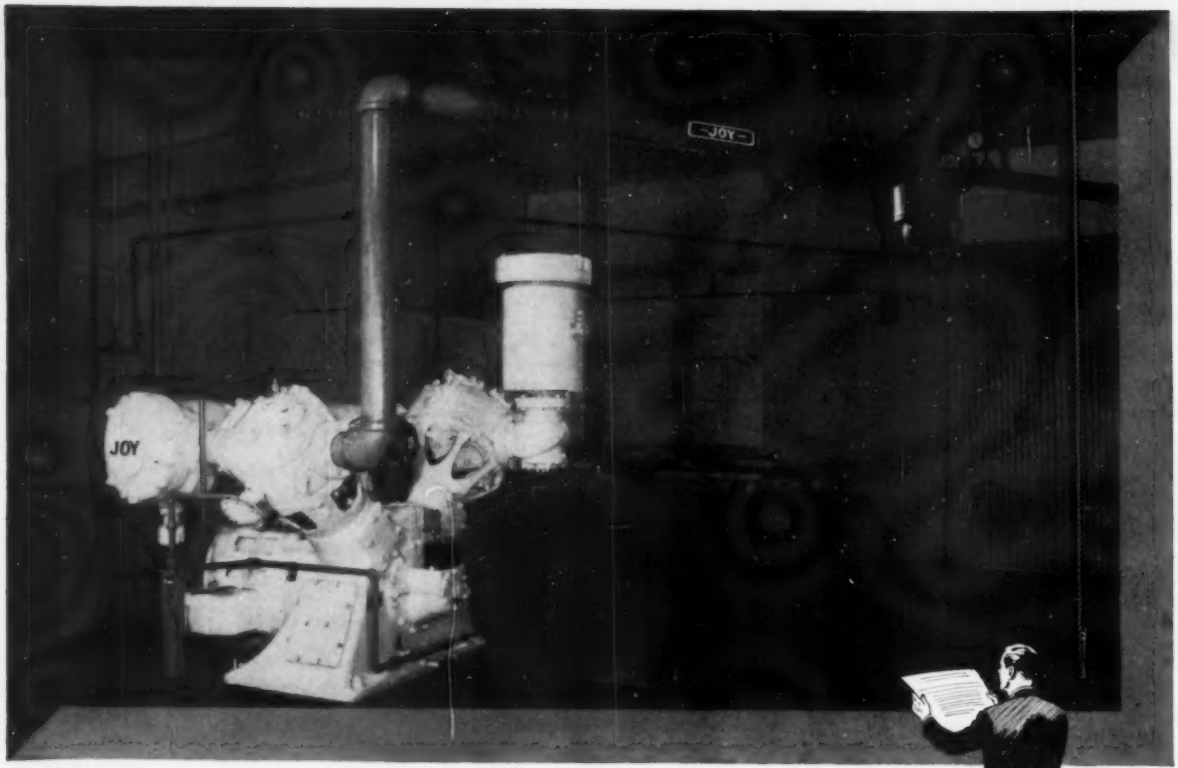

THE CONSULTING ENGINEER REPORTED:

"The Joy WN-112 is the quietest, best compressor in our experience"

This was the report of a group of consulting engineers who, working with the plant engineer, specify plant equipment for some of the country's most important air compressor installations.

That's all the engineers said, but they know Joy compressors are the "quietest and the best" because of these features:

- Honed, REPLACEABLE crosshead and cylinder liners.
- Exclusive "Dual Cushion" Valves—large area, low lift.
- Factory assembly and testing to insure permanent alignment.
- One-piece, box-type, tinned crossheads.
- Full force-feed lubrication.
- Precision crankpin and crosshead pin bearings.

The Joy WN-112 is a heavy-duty, two-stage, double-acting, package-type compressor with displacement capacities from 368 to 974 CFM. Other single-stage, two-stage, and multi-stage Joy stationary air and gas compressors are available in capacities from 2 to 3896 CFM. and pressures from 30 to 600 psi. Write today for descriptive literature • ***Joy Manufacturing Company, Oliver Building, Pittsburgh 22, Pa.*** In Canada: *Joy Manufacturing Company (Canada) Limited, Galt, Ontario.*

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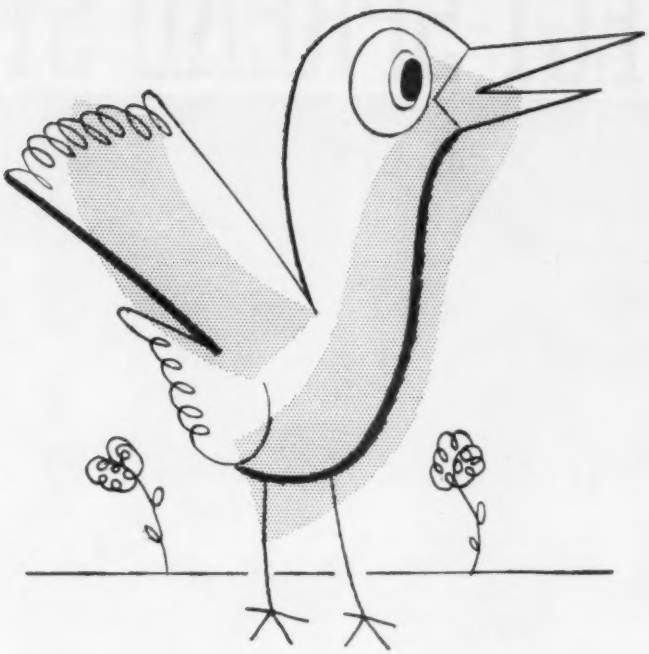


HARD WATER IS FOR THE BIRDS

Maybe birds and flowers like hard water—but we doubt it. Most people don't. Especially those who use large quantities of water, as needed for boilers, processing, water heaters and other services, where ordinary water just won't do.

And that's where Elgin-Refinite comes in. Water softening and conditioning is our business. We have been at it for nearly a half century during which we have come up with some of the most important developments in the field.

For example, our water softener of "Double-Check" design makes possible a deeper zeolite bed which increases soft water output as much as 44% —yet it costs so little more. The ingenious "double-check" arrangement also prevents costly loss of zeolite (this arrangement can be easily installed in your present water softener).

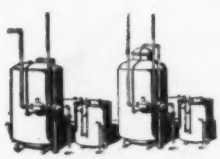
High capacity Elgin zeolites give 3 to 10 times more capacity of soft water output per regeneration. And then there is the outstanding Elgin Ultramatic Water Softener—today's finest fully automatic water softening equipment. Its automatic control mechanism is readily adaptable to any existing water softener.

Yes, if you require soft water in large or small quantities, or any of the water conditioning equipment shown below, let us put the nearest Elgin-Refinite man in touch with you.

Elgin-Refinite • *Division of Elgin Softener Corporation*
130 N. Grove Ave., Elgin, Illinois
Representatives in Principal Cities • In Canada: G. F. Sterne & Sons, Brantford

Elgin REFINITE SINCE 1908

Water Conditioning since 1908



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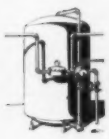

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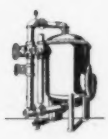
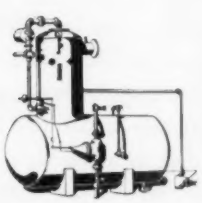
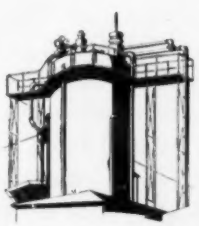


FILTERS

DEGASITORS



DEAERATING HEATERS



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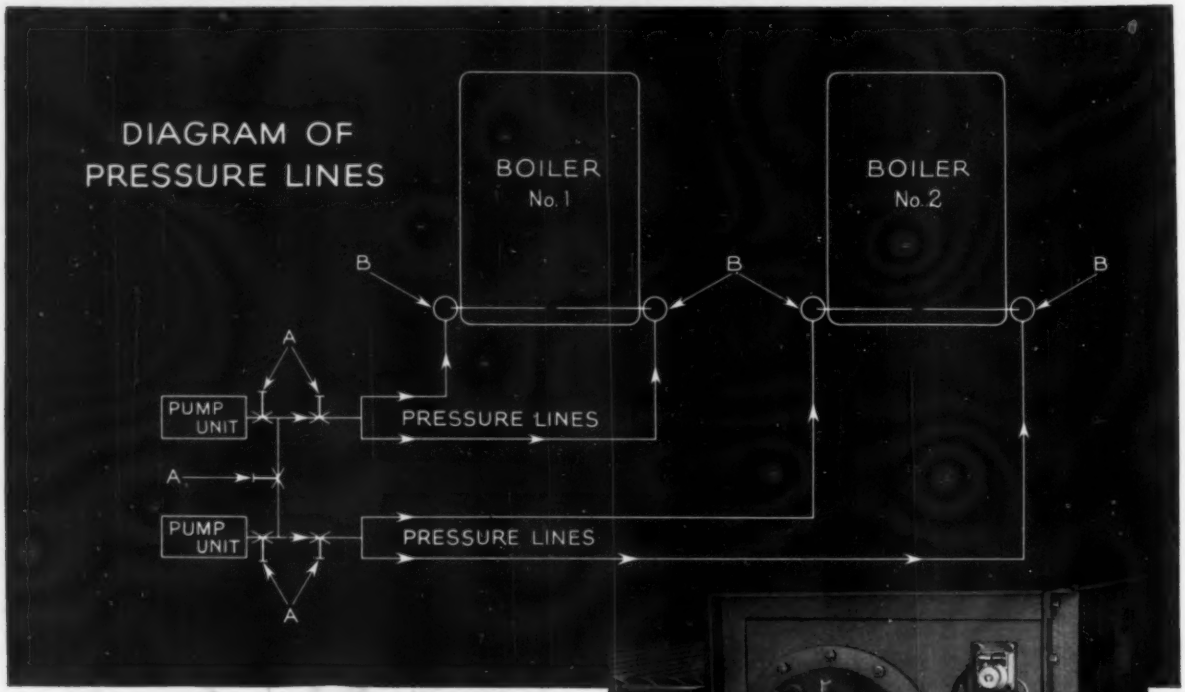
PERFECT SPREAD STOKER



permits hydraulic
dual grate drive
for maximum dependability

ALL Continuous Ash Discharge Perfect Spread Stokers can be driven by a single power unit. The fluid power pump feeds cylinders "B" on both sides of the grate. This hydraulic system makes it easy to interconnect two stokers and provide for *dual drive* . . . assurance of uninterrupted service in an emergency as one pump will drive both grates by opening or closing valves "A" (See diagram).

In addition, the AE hydraulic drive assures smooth operation, requires less power and maintenance, and gives an infinite choice of speeds from zero to maximum. Automatic overload protection built in. Complicated and aisle-blocking reduction gears are eliminated. The pumping unit can be located next to the stoker or at any convenient place in boiler room or basement.

Write for full information about the AE Perfect Spread . . . the stoker that provides true, continuous feeding of 50 to 7500 lbs. of coal per hour per feeder and never clogs, *not even on wet coal.*

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In Plants From Coast-to-Coast

SPECIFY ERNST WATER COLUMNS • LIQUID LEVEL GAGES • Bronze, Forged Steel, Stainless Steel, All Iron and other specialties • For all Pressures and Temperatures • For Boilers, Tanks, Heaters, Refinery Service, etc.

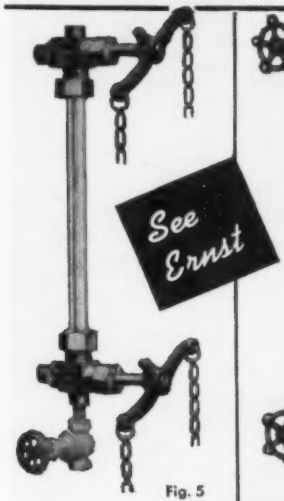


Fig. 5

Standard vertical bronze water gage, 350 pound design.

Fig. 8

All iron gages for pressure up to 250 lbs., heavier construction up to 350 lbs.

Fig. 8SS—Same fittings made in stainless steel.

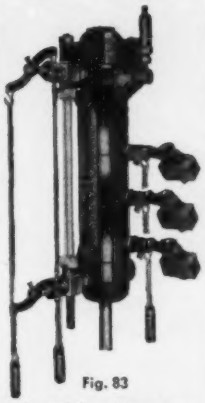


Fig. 83

No. 5 high and low alarm column wth vertical gages and DCP weighted type try cocks.

Wire or Phone Ernst

SPLIT-GLAND GAGE

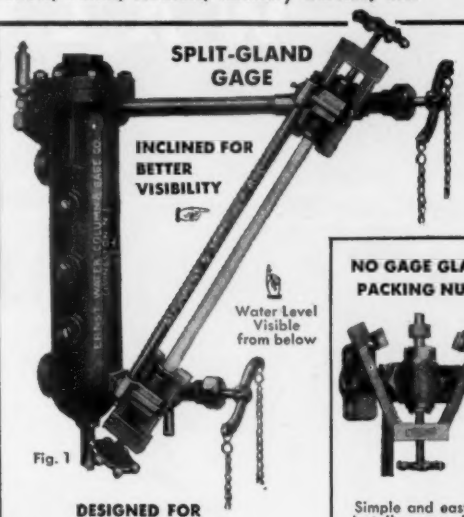


Fig. 1

DESIGNED FOR 250-450-650 LBS. W.S.P.

High and Low Alarm Column Equipped with Split-Gland Type Adjustable Inclined Water Gage

NO GAGE GLASS PACKING NUTS

Simple and easy to install a gage glass. No wrenches or tools required. A turn of the hand wheel compresses the packing.

Insure Safety with ERNST INSERTS

Mica-protected Flat Glass and PRISMATIC REFLEX

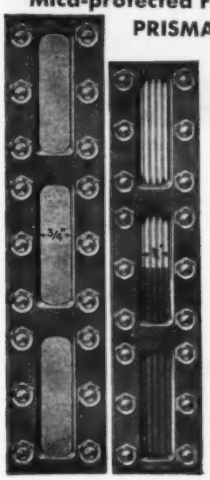


Fig. 44 EXT Fig. 34 EX

Insert units can be combined to make any desirable length for tanks, etc.

Fig. 45

Ernsthru Vision Mica-Protected Single Insert

Fig. 37

Prismatic Reflex Steam Shows WHITE; Water shows BLACK

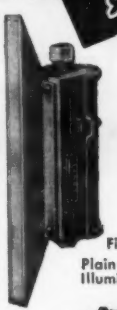


Fig. 10

Plain Sight Illuminator

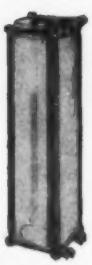


Fig. 31

Ernst Plastic Guard, Replaceable Plates

ERNST LEAKLESS TRY COCKS

Made for all pressures up to 2500 lbs.

Fig. 13

Ernst Leakless Try Cocks Assure Maximum Safety

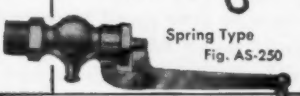
Fig. 01

Bronze, with Wheel

Weighted Type Try Cock

Fig. 15

Bronze, with Iron Weight Double Chain Pull



Spring Type Fig. AS-250

SIGHT FLOW INDICATORS for insertion into pipelines

"See what's going on" . . . inside

Fig. 17-28 Glass Cyl. Type

Fig. E-811 Flapper Type Single Window

Write Ernst

Fig. E-57 Double Window Type

GAGE GLASSES — Tubular and Flat Type

FLAT TYPE REFLEX AND CLEAR

CLEAR AND RED-LINE MAGNIFYING TYPE

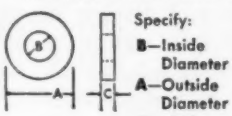
Tubular Glasses Made in Lengths up to 144" Long

And Outside Diameters ⅜", ½", ⅝", ¾", ⅞", 1", 1¼", 1½".

STATE YOUR REQUIREMENTS

High Pressure Composition RUBBER GASKETS

Manufactured in all sizes to fit your water gages



Specify:

B—Inside Diameter

A—Outside Diameter

C—Thickness

Fig. 21—Lip Mold Rubber Gasket

Fig. 22—Standard Rubber Gasket

ERNST WATER COLUMN & GAGE CO.

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ENGINEERING SPECIALTIES FOR MORE THAN 50 YEARS

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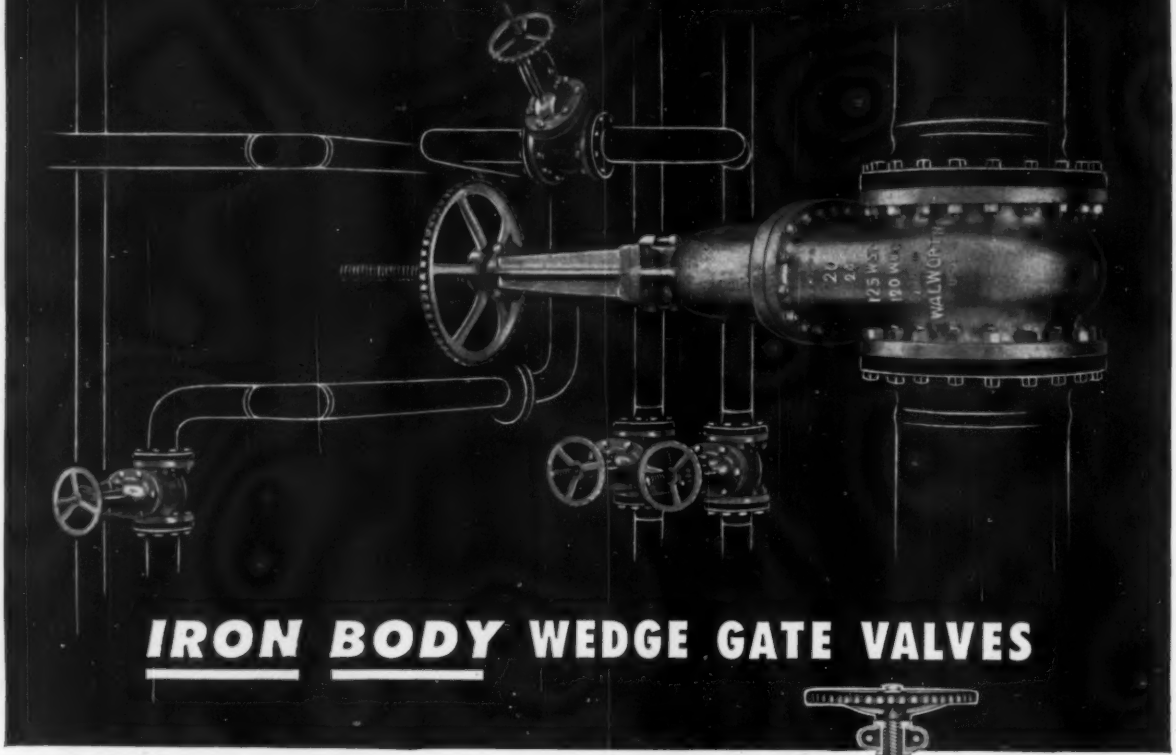

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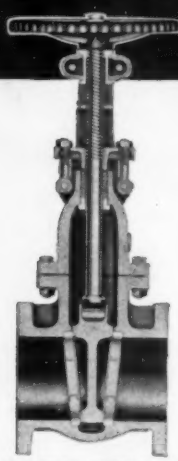
Better because ...**The entire valve, from handwheel to seat rings, is ruggedly constructed to withstand rough and frequent usage. Body, bonnet, and yoke are sturdy castings with large radius fillets. Dimensions and drilling of end flanges are in agreement with American Cast Iron Flange Standards. Stiffening ribs connect end flanges with the body neck to maintain a rigid connection with piping.**

A wide range of Walworth Iron Body Wedge Gate Valves is available—through your Walworth Distributor—from which you can choose the right type to meet your most exacting conditions. Saddle-type valves as small as ¼-inch; low pressure valves for water and gas pipelines up to 36 inches.

Whenever you need valves and fittings, choose from complete lines—in a variety of metals—manufactured by Walworth. For more information, see your Walworth Distributor or write: Walworth Company, General Offices, 60 East 42nd Street, New York 17, N. Y.



Walworth No. 726F OS&Y (Outside Screw and Yoke) Iron Body Wedge Gate Valve. OS&Y valves are recommended for services where it is desirable that the line fluid does not come in contact with the stem threads. Note the swing-type gland-eye-bolts for easy repacking. Sizes 2 to 30 inches.

WALWORTH

Manufacturers since 1842

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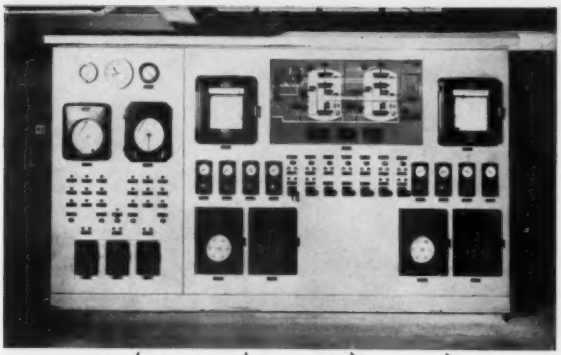


10,000,000 ohm-cm.

10,000,000 ohm-cm.

10,000,000 ohm-cm.

10,000,000 ohm-cm.

10,000,000 ohm-cm.

10,000,000 ohm-cm.

10,000,000 ohm-cm.

NOW...10,000,000 ohm-cm. water!

at 160 gpm for 2050 psig boilers... by Demineralization

Just a few years ago, producing large quantities of water of a purity of 0.01 ppm was quite a chore. A tedious, drawn out multiple distillation technique was required. Engineers "dreamed" of producing this water at large flow rates for high pressure boilers and power plants by an easier and more economical method.

Today, at the Pennsylvania Electric Company, Shawville Station, this has become a reality. Makeup for 2050 psig boilers is produced at a rate of up to 160 gpm and with a purity of 10,000,000 Ohm-cm (0.01 ppm) and **less than 0.02 ppm silica** by a fully automatic Graver Mixed-Bed Demineralizer with in-built dependability.

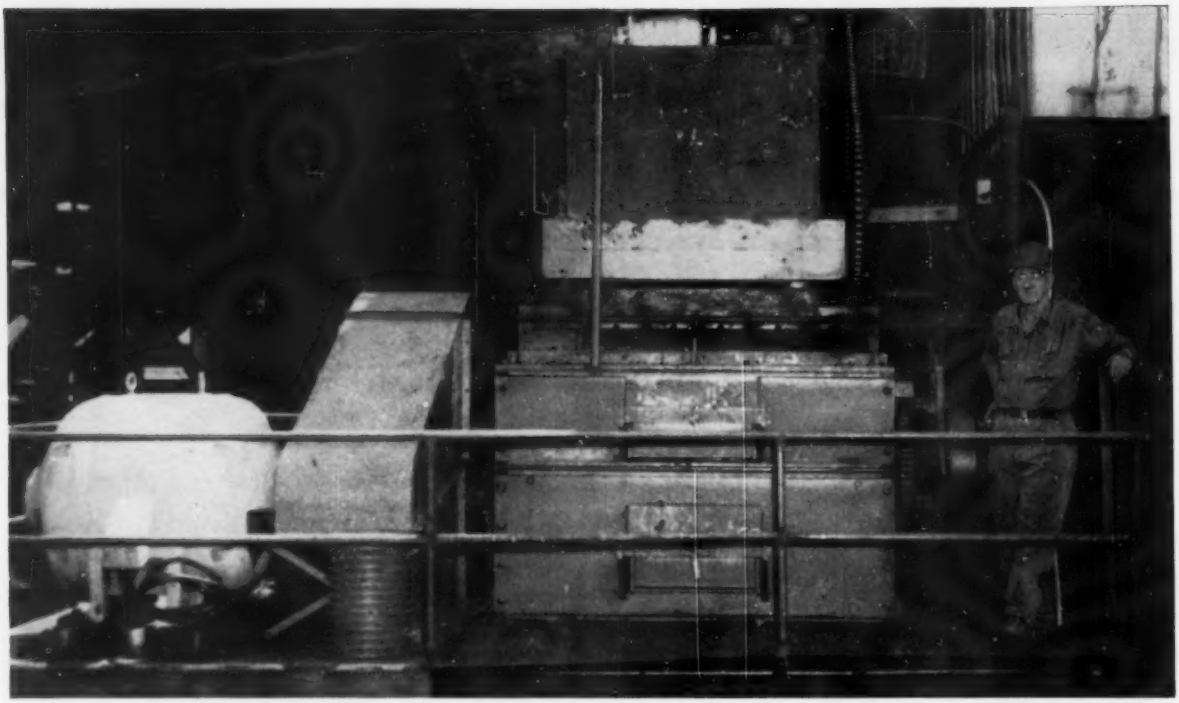
Write for new Demineralizing Bulletin.

GRAVER

GRAVER WATER CONDITIONING CO.

A Division of Graver Tank & Mfg. Co., Inc.

216 West 14th Street, New York 11, N.Y.



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Crushes Up to 80 Carloads (50 Ton Cars) per 7 Hour Day... Reduces Feed Size 8" x 1¼" Washed Coal to 1¼" x 0

This American AC-7-B Crusher was installed with a guaranteed capacity of 440 tons per hour. It has been operating at tonnages up to 584 tons per hour—and maximum output has never been reached, according to the mine's Director of Preparation.

THE REQUIREMENTS WERE:

- High capacity crushing.
- Flexibility in the sizing of the crushed product.
- Consistent sizing for any size feed up to 8"
- Minimum of fines.

Find out how your plant can maintain high production plus full sizing flexibility at low operating costs. Write for American AC Coal Crusher Bulletin.

THE RESULTS:

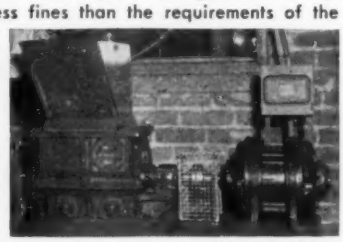
CAPACITY—Reducing 8"x1¼" to 1¼"x0, the American Crusher produced 584 TPH, a 32% increase over guaranteed capacity.

FLEXIBILITY OF SIZING—Whenever a 1" or 1½" product is desired, the sizing can be adjusted externally by means of the Adjustable Drop Cage. Further, the AC-7-B can be adjusted in less than two minutes to produce a 4"x0 product. This flexibility in sizing helps meet the changing market demands of this mine's contracts.

MINIMUM OF FINES—The crushed product, regardless of size being made, contained less fines than the requirements of the mine contracts.

. . . and for low-cost coal sample crushing

The American Sample Crusher, with the new Adjustable Sampling Hopper; gives you 5%—10%—15% or 20% sample of a sample — in one operation.



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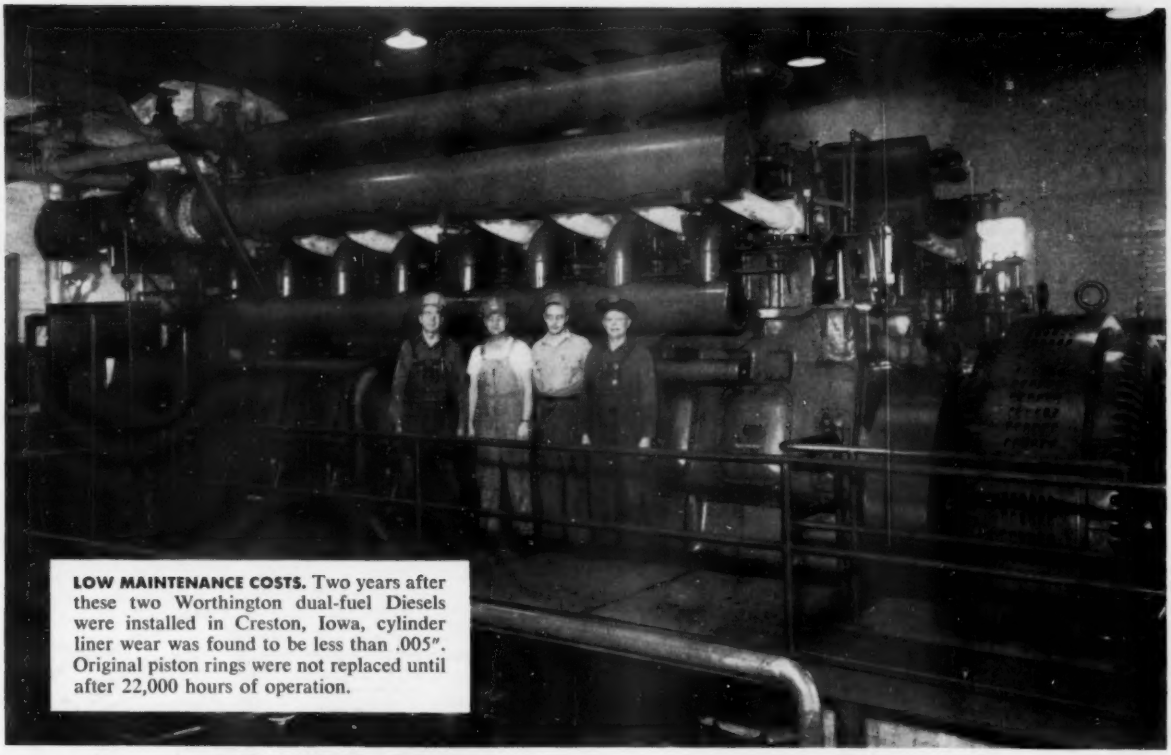
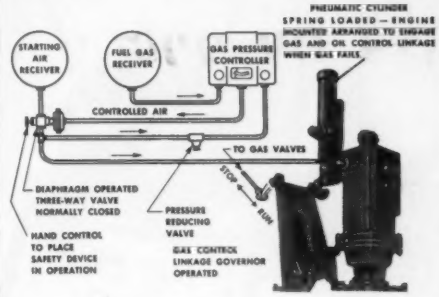


LOW MAINTENANCE COSTS. Two years after these two Worthington dual-fuel Diesels were installed in Creston, Iowa, cylinder liner wear was found to be less than .005". Original piston rings were not replaced until after 22,000 hours of operation.


PNEUMATIC CYLINDER
SPRING LOADED — ENGINE MOUNTED ARRANGED TO ENGAGE GAS AND OIL CONTROL LINKAGE WHEN GAS FAILS
STARTING AIR RECEIVER
FUEL GAS RECEIVER
GAS PRESSURE CONTROLLER
CONTROLLED AIR
TO GAS VALVES
STOP
RUN
DIAPHRAGM OPERATED THREE-WAY VALVE NORMALLY CLOSED
HAND CONTROL TO PLACE SAFETY DEVICE IN OPERATION
PRESSURE REDUCING VALVE
GAS CONTROL LINKAGE GOVERNOR OPERATED

WORTHINGTON'S NEW "AUTOMATIC FUEL SWITCHER" used on Worthington dual-fuel engines eliminates shutdowns due to fuel gas interruptions or failures. When gas pressure drops below normal, or fails completely, the Automatic Fuel Switcher instantly and automatically changes the engine over to 100% fuel oil.

The fuel switcher closes the gas metering valves instantly and simultaneously shifts linkages that place the fuel pumps under control of the governor at the required setting for the load at that moment. There is no hunting of the governor when the engine goes over to 100% fuel oil.

Iowa Southern meets new power demand with Worthington dual-fuel Diesels

The Iowa Southern Utilities Company, with headquarters at Centerville, serves an area of more than 1000 square miles.

In 1949, Iowa Southern installed two Worthington dual-fuel Diesel engines in their Creston plant to make use of "dump" gas in the warm weather months and peaking in the cold weather months. Voltage and power factor corrections are valuable by-products the year around. By 1952, however, population increases boosted power demand to the point where the Worthingtons ran 80 percent of the time during the year, producing more than 15,200,000 kw hours that year.

This pair of Diesels, with a full-load capacity of 2320 kw, take up less space than their predecessors, two steam engines rated at only 550 kw. Replacing the old steam equipment also paid off in substantial fuel savings — the dual-fuel Diesels run on low-cost natural gas during much of the off-season.

Savings like these are a big factor in the trend toward using dependable Worthington dual-fuel Diesels for handling base or peaking loads. Write for facts to your nearest Worthington district office or Worthington Corporation, Engine Division, Section E.4.14, Buffalo, N. Y. E.4.14

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Economical, Continuous Power — Diesels, Dual-Fuel and Spark-Ignition Engines, from 200 to 5,000 bhp.

BE THE JUDGE

and the Jury, too...

consider the **FACTS**

about BROWN BOVERI TURBO-GENERATORS

weigh the evidence

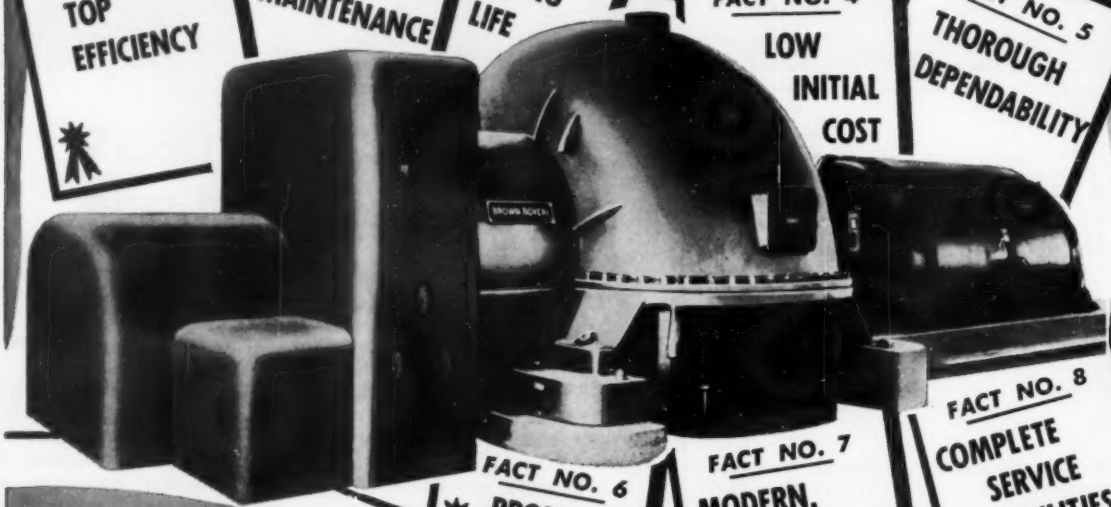
FACT NO. 1 TOP EFFICIENCY

FACT NO. 2 MINIMUM MAINTENANCE

FACT NO. 3 LONG LIFE

FACT NO. 4 LOW INITIAL COST

FACT NO. 5 THOROUGH DEPENDABILITY



FACT NO. 6 PROMPT DELIVERY

FACT NO. 7 MODERN, COMPACT DESIGN

FACT NO. 8 COMPLETE SERVICE FACILITIES

These facts apply to Brown Boveri Turbo-generators . . . plus, of course, world-famous Brown Boveri quality. The verdict, on the basis of facts, is—Brown Boveri is the "buy". That's why astute cost- and quality-conscious industrials, utilities and cooperatives specify Brown Boveri. It will pay you to get more details about these Turbo-generators.

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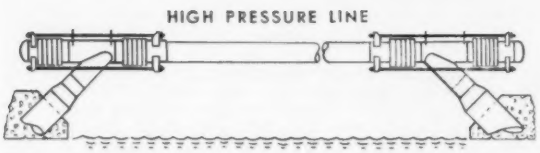
Typifying Joint Engineering at its Best

THE "*Balanced*" JOINT



Picture a pipe line not only "hot" but also under high pressure. At any point where the pipe line changes direction abruptly, two distinct problems are involved: the usual thermal expansion but equally important, the terrific thrust created by the line pressure. Some means must be provided for 'holding' the pipe which in most installations can be securely anchored to a supporting structure. There are cases however, when this is not possible.

How can such a problem be handled?

This "Balanced" joint was designed for just such unusual problems. The unit consists of two joints tied together with four heavy rods. One end of the unit which is anchored at the center is blanked off. The rods balance the internal pressure. Thus, the only force exerted on the intermediate anchor is the force required to open and close the joints.

During the past few years we have engineered a number of these "Balanced" joints. The joint illustrated above was designed for use on a turbine, where it was necessary to reduce the stresses on the turbine casing. In another typical case (see sketch) "Balanced" joints were used to relieve the stresses on a bridge carrying a high pressure gas main. The anchor force was reduced from 245,000 pounds to 14,000 pounds.

This same engineering skill and flexibility in thinking is back of the other special joints as well as standard packless, corrugated joints with which the name Badger has for so long been associated. These are the joints you can trust to serve you well.

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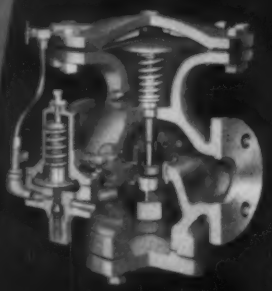

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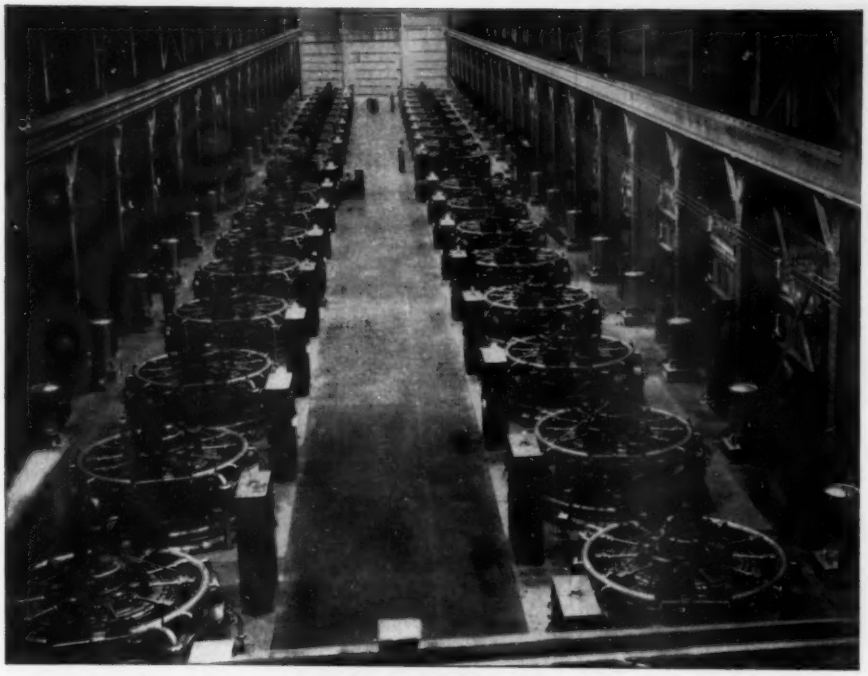


A view of 40 of the 80 gas-burning radial engines used to produce electricity for the Chalmette, Louisiana reduction plant of Kaiser Aluminum and Chemical Corp. These engines, built by Nordberg Mfg. Co., Milwaukee, Wisc. have crankshafts of high strength nickel alloy cast iron, and aluminum alloy pistons with Ni-Resist ring carrier bands.

Ni-Resist Inserts mean Longer Life for Nordberg Engines

THE TOP RING AREA of a gas or Diesel engine is exposed to the most heat, receives least lubrication, and faces attack from abrasive dust and dirt. It is here that wear tends to be excessive in engines equipped with aluminum pistons. The result is higher oil consumption as well as lost power due to "blow-by."

A sure solution to these troubles are engines equipped with aluminum alloy pistons that have NI-RESIST® ring bands. The high expansion properties of Ni-Resist prevent warping and failure of the joint between the two metals.

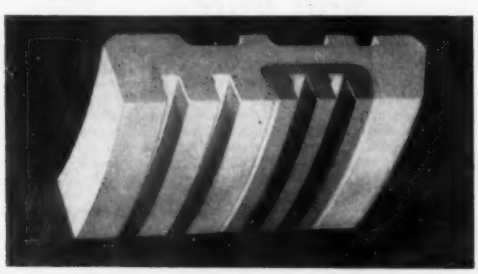
Records of engines so equipped show greatly improved piston life and increased power per cylinder, because the Ni-Resist bands combine outstanding resistance to heat, corrosion, metal-to-metal wear and galling.

No other cast metal provides such a useful combination of engineering properties.

In fact, the trend to increase engine output by using chemically treated fuels and higher operating temperatures, make Ni-Resist a material of importance to all engine owners.

Other Ni-Resist engine applications include exhaust valve guides, cylinder liners, exhaust manifolds, connector rings, exhaust seat rings and ball joints, water pump impellers and bodies. Insist on Ni-Resist in original equipment or replacement parts.

Several types of Ni-Resist are available to meet a variety of industrial demands. Get full information . . . mail the coupon now.



Section of Ni-Resist ring carrier band made an integral part of aluminum alloy piston.

The International Nickel Company
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Please send me booklets entitled "Engineering Properties and Applications of Ni-Resist" and "Buyers' Guide for Ni-Resist Castings."

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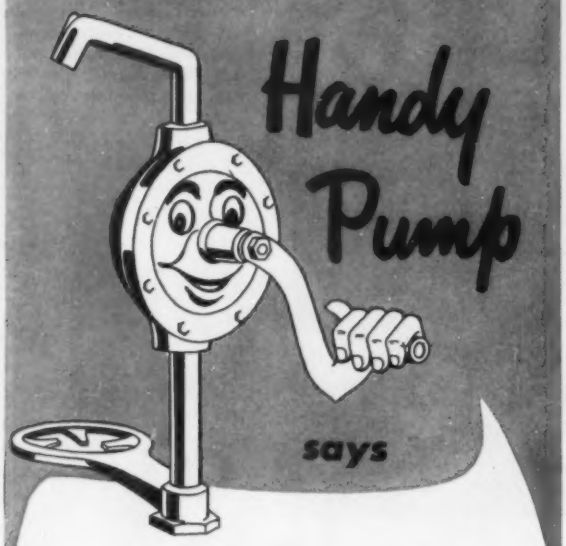

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SPECIFICATION No. 4132. Both circuits open at intermediate pressure. One circuit closes on increase of pressure above neutral zone—second circuit closes on decrease in pressure below neutral zone.
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WRITE FOR BULLETIN NO. 92.

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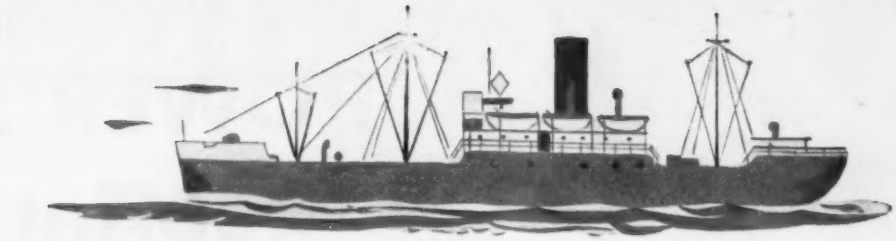

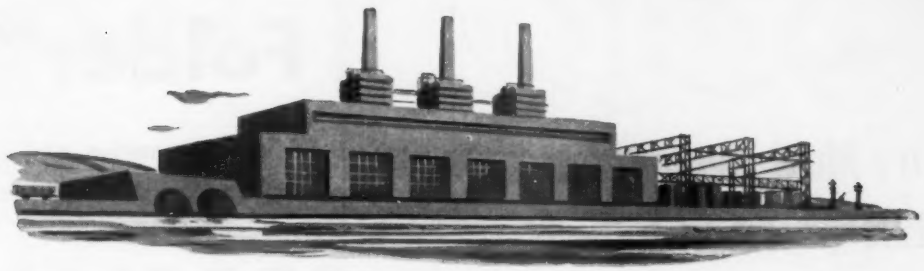

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Bridgeport 70-30 Cupro Nickel (Alloy 531) is giving excellent service in sea-water power plants, both afloat and ashore. Its resistance to general and impingement corrosion from clean sea water, especially at high velocities, offers advantages over other alloys in many applications. Metallurgists have developed Alloy 531 by adding 0.40 to 0.70% iron to ordinary 70-30 Cupro Nickel, thereby increasing its resistance even further.

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To use the advantages of Bridgeport Cupro Nickel, or any of the other Bridgeport Condenser Tube Alloys to solve your corrosion problems, call your nearest Bridgeport Sales Office. They'll welcome the opportunity to discuss your requirements and also to tell you about Bridgeport's Technical Service.

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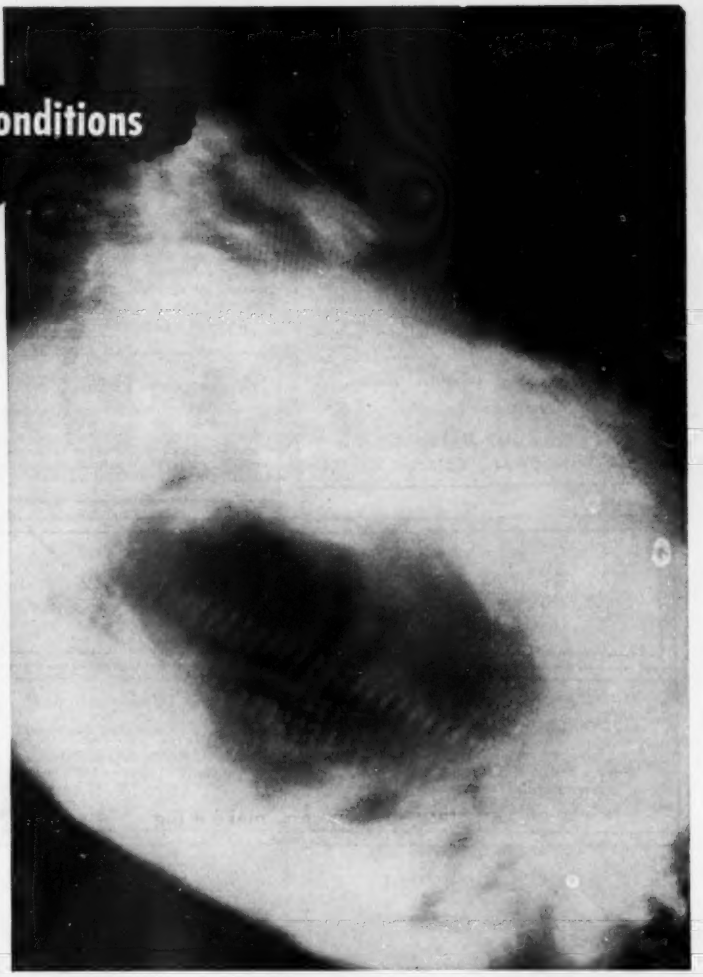

. . . with RCA Industrial TV

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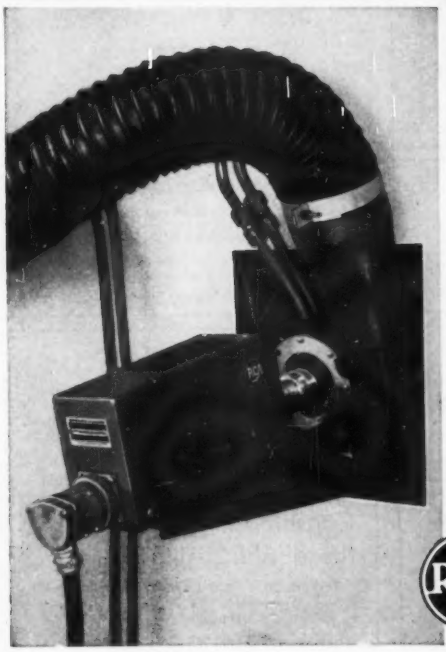

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FOR INFORMATION on RCA Industrial TV (Type ITV-5A), write Radio Corporation of America, Dept. I-208, Building 15-1, Camden, New Jersey.

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TO manufacturers of equipment and those offering special services to the power industry, this section offers an inexpensive means of keeping products or services regularly before your potential customers — the readers of POWER. The small spaces available here provide opportunity for you to be represented in every issue at low cost. Can we serve you?

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A complete picture of the job a control system must do and how it goes about it. Detailed descriptions of complete control systems and devices used in them, including systems developed by leading manufacturers. *Per copy 60¢. 100 or more, 50¢ each.*

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What You Need to Know About Air Properties – The Necessary Tools – Heating and Cooling – Moisture Control – Air Distribution – Refrigeration – How to Fit Equipment to the Job. *Per copy 60¢. 100 or more, 50¢ each.*

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The reaction by which fuel and oxygen combine and give off heat is the most important single process in our universe. In 48 practical pages, this section tells how fuels burn, gives facts about commercial fuels, describes firing equipment, shows how to select fuels wisely for new plants and old, and outlines short-cut methods for checking efficiency. *Per copy $1.00. 100 or more, 80¢ each.*

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More steam turbine capacity is installed in both central stations and industrial plants than of all other prime movers combined. This 48-page special section covers fundamental principles, construction details, types and applications, governing, lubrication, operation and maintenance, and methods of estimating performance. *Per copy, $1.00. 100 or more, 80¢ each.*

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NEW ADVERTISEMENTS, N. Y. Office, 330 W. 42nd St., N. Y., for the October issue closing September 16th.

CHEMICAL ENGINEER WANTED

The Tennessee Valley Authority needs an experienced boiler feed-water control engineer for high-pressure, high-temperature steam plants in its Division of Power Operations located at Chattanooga, Tennessee. This is a staff engineering position. Salary range, $4735-$6575, depending upon training and experience. Applicants must have a college degree in Chemical Engineering or equivalent. Retirement benefits, annual and sick leave, 40-hour week.

Write to the

TENNESSEE VALLEY AUTHORITY

Division of Personnel

Knoxville or Chattanooga, Tenn.

ELECTRICAL ENGINEER

The Engineering and Construction Department of an integrated petroleum company is looking for a graduate E.E. to supervise section engaged in the application of electric power, specification and selection of equipment, negotiation and supervision of utility contracts, plant and system improvements, inspection and testing, and special studies of electrical materials equipment and maintenance.

Must have responsible experience in Industrial application of electric power. Control and distribution systems and the design, specification, construction, installation, operation and testing of electrical equipment. Starting salary $11,600. Send resume in confidence to H. M. OVERLEY, P. O. Box 7258, Philadelphia 1, Pa.

ENGINEER

Large manufacturer of compressed gases requires an engineer of Spanish descent for multi plant operation in South America. Prefer young man, 25-30 years of age with chemical or mechanical engineering degree. Must have operating and engineering experience. Person selected for this job will report to Foreign Plants District Superintendent and travel to several South American countries on supervision of gas plants. He will be required to live in Cuba. Starting salary $5,000.00 annually. Please submit complete details in first letter regarding personal and business history, also recent snapshot, if available.

ADDRESS: PERSONNEL DEPARTMENT

THE LIQUID CARBONIC CORP.

3100 S. Kedzie Ave., Chicago 23, Ill.

AGENTS WANTED

to sell Shear-Klean Grates. For over 40 years nothing has equalled them. Used by thousands of Manufacturing Plants and Institutions. Good commission or discount. Write:

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18 East Erie St., Chicago 11, Illinois

REPLIES (Box No.):
Address to office nearest you
NEW YORK: 330 W. 42 St. (36)
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SAN FRANCISCO: 68 Post St. (4)

POSITIONS VACANT

WE NEED These Men: Power Plant Maintenance Supervisor and Shift Operating Supervisor modern pulverized coal fired, high pressure Steam Generating Station. Excellent working conditions and employee benefits. Medium sized company, with good financial rating. Location—Southern Indiana. Write, giving complete information on educational and experience background, plus salary requirements. All replies will be held confidential. P-3353, Power.

MECHANICAL PLANT Betterment Engineer—Required by operating division of service organization, College graduate preferred, having five to ten years experience in operation and betterment of steam plants operated by public utilities. Location New York—some travel; Spanish desirable, but not necessary. Reply by letter giving age, education, experience, personal data, and minimum salary acceptable. P-3392, Power.

ASST. LOAD Dispatchers—Experienced men for modern power generating and distribution system. Starting salary $371 with increases to $452. Apply to Personnel Department, City Hall, Pasadena, Calif.

SELLING OPPORTUNITY OFFERED

NATIONAL SALES Distributor, a Professional Engineer has a new furnace for burning soft coal, no smoke, fly ash or clinkers, 80% combined efficiency. Available to strong sales organization in the heating and industrial power field. Fully patented, performance and sales tested. RW-3457, Power.

EMPLOYMENT SERVICE

SALARIED PERSONNEL, $3,000-$25,000. This confidential service established 1927 is geared to needs of high grade men who seek a change of connection under conditions assuring, if employed, full protection to present position. Send name and address only for details. Personal consultation invited. Jira Thayer Jennings, Dept. G, 241 Orange St., New Haven, Conn.

POSITIONS WANTED

CHIEF ENGINEER with broad experience in administration and operation of industrial and utility steam power plants, any fuel. Tests, studies, planning, some design and project work. E.E. Degree, age 45. PW-3637, Power.

ENGINEER, M.E. Degree, desires position as Sales Engineer with Nuclear Equipment firm. 20 years experience in heating, refrigeration, ventilation, air conditioning, power plant, electric power, heat treating, chemicals, controls. PW-3735, Power.

A REAL OPPORTUNITY

FOR SALES-MINDED MECHANICAL and COMBUSTION ENGINEERS calling on manufacturers who have boiler plants. Excellent additional line or opportunity to be in your own profit-making business with our assistance and cooperation. We manufacture FYR-FEEDER Industrial Stokers, Conveyors and Grates, and design boiler furnaces for the efficient burning of hogged waste wood and bark (wet or dry), planer chips, sawdust and/or coal.

With FYR-FEEDER firing, supplementary fuel purchases, such as coal, gas and oil, are greatly reduced or eliminated. FYR-FEEDER users make more steam and report big SAVINGS in labor, fuel and increased production.

FYR-FEEDERS are sold on Standard Terms but can also be secured on our PAY-OUT-OF-SAVINGS Purchase Plan. For prompt reply . . . WRITE

FYR-FEEDER ENGINEERS
18 East Erie St., Chicago 11, Illinois
Div.-American Coal Burner & Wood Stoker Corp.

BOILER ROOM OPERATORS

With experience and familiar with Bailey Combustion control for modern high pressure Steam electric generating plant in Pasadena, California. Starting salary $336.00 with Periodic increases to $408.00. Good Promotional opportunities. Apply now for Immediate vacancies.

Personnel Department, Room 200, City Hall
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GET 2nd ENGINEER PAPERS IN 1 YEAR

(Yes, get better stationary engineers License!)

No correspondence school bother. Nationally-known Chief Stationary Engineer Frederick C. Walker's 100-Question, 100-Answer Bulletins give you the straight dope quick. Send $3 to Walker & Collins, 524 Ashland Ave., Buffalo 22, N. Y. for first set today. Keep working. Save year.

OVER 2000 SALES AGENTS!

The new, 1954 edition of POWER's "Directory of Manufacturer's Agents Serving the Power Field" lists over 2,000 sales agencies, in every state and in virtually every country. Limited edition. Price $10.

POWER

330 W. 42nd St., New York 36

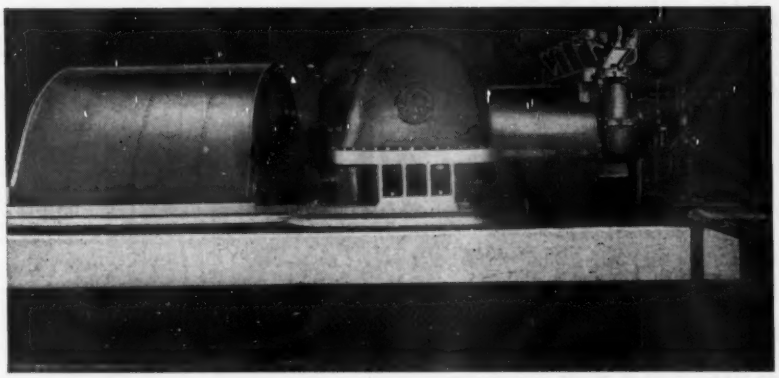
3750-KVA. ALLIS-CHALMERS-400# PSIG, 750° F.T.T. TURBINE-GENERATOR NEW 1948-EXCELLENT CONDITION

Above view of our Allis-Chalmers 3750 KVA Condensing Turbine Sets, just released, offered here for the first time. Is complete with 2-pass Surface Condenser capable condensing 34,500# steam per hour, Switchboard with instruments, Exciter direct connected and has had limited service and ready now for immediate delivery. Voltage: 3/60/2300/4160 Volt. Steam Pressure: Initial 400# PSIG, 750° F.T.T.

OTHER UNITS AVAILABLE:

1—2000 KW Gen. Elect. Cond.—440#—750° F.T.T.—2300 V.
1—2000 KW Al.-Chal. Cond.—400#—750° F.T.T.—2300 V.
1—1500 KW Gen. Elect. Cond.—410#—750° F.T.T.—2300/4160 V.
1—2000 KW West., Non-cond.—250#—600° F.T.T.—40# B.P., 2300 V.
1—1250 KW West., Non-cond.—150#—600° F.T.T.—15# B.P., 2300 V.
1—1250 KW Gen. Elect., Non-cond.—200#—600° F.T.T.—15# B.P., 480 V.
2— 750 KW West., Non-cond.—150#—600° F.T.T.—15# B.P., 2300 V.

3750-KVA. G. E., 400#, 750° F.T.T. TURBINE-GENERATOR



Above view was made from a recently taken photograph of the 3750-KVA. G.E., Turbine. It is a condensing machine complete with 2-pass, 6000 sq. ft. Surface condenser, Switchboard with instruments, D.C. Exciter. Voltage is 3/60/2300-4160-V.

MACHINE CAN BE INSPECTED IN OPERATION

We own and offer any Capacity Turbine from 300-KW to 12,500-KW. Complete line of Boilers, also Diesel Engines. Send us your specs.

TELEPHONE WIRE OR WRITE.

CHARLES WEAVER
4145 PENOBSCOT BUILDING
DETROIT 26, MICHIGAN

TELEPHONE: WO. 1-1340

INVESTIGATORS WELCOME!

THE CLOSER YOU LOOK
THE MORE YOU'LL BE SATISFIED
WITH THE QUALITY AND ECONOMY OF

HEMPHILL *Guaranteed* EQUIPMENT

OIL CIRCUIT BREAKERS

3—600 AMP. G. E. FKR-55-20, 15,000 V. 3 P. 100,000 KVA, SOLENOID OPER.

TRANSFORMERS—60 Cycle

Qu.	KVA	Make	Type	Ph	Voltages
1	1000	G.E.	Auto	3	4150x2400
1	750	G.E.	HT	3	4150x120/240
2	750	G.E.	H	1	4600-120/240
1	500	Kuhl.	OISC	1	4150x2400
2	400	Pitts.	OISC	1	4800/4150/2400 x240/480
1	333	G.E.	H	1	13200x220/440
2	300	G.E.	H	1	13200x440
4	200	G.E.	H	1	13200x440
1	200	G.E.	HT	3	2400x240
2	150	Pitts.	ODSC	1	240x120/240
3	50	G.E.	H	1	4800x120/240
3	50	A.C.	H	1	230x120/240
1	25	G.E.	H	1	460x120/240

SLIP RING MOTORS

Qu.	H.P.	Make	Speed	Type	Volts
1	500	G.E.	1200	M	2400/4150
1	400	Whse.	450	CW	550
1	250	Whse.	60	CW	440
2	200	Whse.	600	CW	440
1	200	G.E.	600	MT	440
1	150	A.C.	1800	AY RW	2300
1	100	G.E.	1800	IM	220
1	100	G.E.	600	IM	440
1	75	G.E.	600	IM	440
3	60	G.E.	1800	MT	220

DC, 230 VOLT MOTORS

Qu.	H.P.	Make	Speed	Type
1	300	G.E.	1200	MPC
2	150	C.W.	900	WP
1	125	G.E.	1700	RC
2	75	C.W.	900	WP
1	30	C.W.	700	CM
1	35	G.E.	880	RC
1	25	Whse.	835	SK

SQUIRREL CAGE MOTORS

Qu.	Make	Speed	Type	Volts
150	G.E.	720	KT	440
125	G.E.	3560	KP	2300
100	G.E.	1200	FTR	220
75	Ideal	1200	AT	220/440
60	G.E.	1200	KT	220
50	G.E.	3560	FT	220
50	G.E.	600	KT	440
40	G.E.	3550	FT	440
30	G.E.	600	KT	440

• THE HEMPHILL SEAL OF *Satisfactory* SERVICE

JLHCo

Member of The National Industrial Service Association, Inc.

MOTOR GENERATOR SETS

Qu.	KW	Make	Speed	DC	AC
1	1000	G.E.	514	600	2300/4150 Syn.
1	1000	Whse.	720	600	2300/4150 Syn.
1	750	Whse.	720	275	2300/4150 Syn.
1	300	C.W.	1200	230	3-unit 2400/4150SR
1	300	G.E.	1200	230	2400/4150SR
1	200	Whse.	900	250	2300/4150 Syn.
1	150	C.W.	1200	230	440 SC
1	150	3 Unit G.E.	1200	125/250	2300 Syn.
1	150	Whse.	600	125	4150 Syn.
1	125	C.W.	1200	125	2300 S.C.
1	100	G.E.	900	250	2300 Syn.
3	60	G.E.	1200	125	208 Syn.
2	30	G.E.	1200	125	440 SC

SYNCHRONOUS MOTORS

Qu.	H.P.	Make	Speed	Type	Volts
1	300	El. Mach.	720	TEFC	2200
3	200	Whse.	720		4150
1	175	G.E.	720	ATI	2300
1	150	G.E.	720	ATI	2300
1	150	G.E.	1800	TS	220
1	150	Whse.	900	ISIG	220

SPECIAL

A.C. Welding MG Set

176 KVA 1200 RPM 1 Phase 220 V. 800 Amps. 57 PF motor 1160 RPM. 440 2 3 Ph. S.R. direct connected exciter and flywheel.

THIS SEAL GUARANTEES INSPECTION BY HEMPHILL ELECTRICAL ENGINEERS

"FOR POWER"
J.L. HEMPHILL & CO.
1603 54th STREET, NORTH BERGEN, N. J.
PHONE NEW YORK—LONGACRE 5-3227
PHONE NEW JERSEY—UNION 5-2500

COMPLETE POWER PLANTS

STEAM — ELECTRIC — HYDRO — DIESEL

Boilers *"Export Orders Carefully Executed"* Boilers

TRY US with your INQUIRIES for ALL POWER MACHINERY

CHARLES B. REARICK 30 CHURCH ST. NEW YORK 7, N. Y.

We Own For Immediate Delivery

AIR COMPRESSORS

2—NEW, I. R., 3580 CFM @ 100 PSI

PURCHASED NEW, SEPT., 1952—NEVER INSTALLED
OFFERED AT A SUBSTANTIAL SAVINGS

2—30 & 8 x 22, I. R., Type PRE-2 Compressors, 5 step control, 200 RPM, with direct connected G.E. Synchronous Motors 600 HP, 3/60/4160 unity P. F., G. E. full voltage magnetic controllers, 10 KW, M. G. Sets for excitation, aftercoolers, and automatic condensate traps.

BOILERS

12—304 HP Kewanee Firebox Boilers, Model 590, 125 PSI, with oil burners & soot blowers, ASME.

4—150 HP Casey Hedges HRT Boilers, 150 PSI, gas fired, ASME.

HEAT & POWER CO., INC.

70 PINE STREET HANOVER 2-4890 NEW YORK 5, N. Y.

NEED AIR?

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AMERICAN AIR OF JERSEY

AIR FOR SALE OR RENT

SINCE 1902

GAS • DIESEL • STEAM • ELECTRIC

NEW AND QUALITY REBUILTS

PORTABLE

55 CFM Lindsay (GAS)
60 CFM LeRoi—CPT—Worth (GAS)
105 CFM Joy—Worth—CPT (GAS)
160 CFM Worthington (GAS)
210 CFM Worthington (GAS & DIESEL)
270 CFM Sullivan w/Buda Power Unit—Skids
315 CFM Worthington (GAS & DIESEL)
500 CFM Worthington (DIESEL)
600 CFM Worthington (DIESEL)

STATIONARY

80 CFM 6 x 5 Worthington HB—10 HP Elec
122 CFM 7 x 7 Worthington HB—20 HP Elec
165 CFM 60 PSI 8x7 CPT—TB
168 CFM 135 PSI 8x9 CPT—TB
294 CFM 125 PSI 10x11 Worth—HB
211 CFM 9 x 9 Ingersoll—ES-I—40 HP Elec
364 CFM 20 PSI 12 x 7 Gardner Denver
368 CFM 100 PSI 12x10 IR—ERI
905 CFM 55 PSI 17x13 CPT—TB
1085 CFM 35 PSI 20 x 12 Pennsylvania
1452 CFM 70 PSI 15/15 x 14 Penn Duplex

MANY OTHERS TO CHOOSE FROM

AFTERCOOLERS—AIR RECEIVERS
VACUUM PUMPS

354 CFM 14 x 5 Penn—15 HP
434 CFM 14 x 7 Ingersoll 15-20 HP
720 CFM 18 x 7 Worthington 25-30 HP
1184 CFM 22 x 9 Chicago 40-50 HP
1633 CFM 24 x 11 Chicago 60 HP

American
AIR COMPRESSOR CORP.
DELL AVE. & 47th ST.
NORTH BERGEN, N.J.
Telephone UNion 5-4848

RE-NU-BILT
GUARANTEED

ELECTRIC POWER EQUIPMENT

D. C. MOTORS

Qu.	H.P.	Make	Type	Volts	RPM
1	2200	G. E.	MCF	600	400/500
1	2000	Whse.	Mill	600	230/460
1	1200	G. E.	MCF	600	750/950
1	940	Whse.	QM	250	140/170
1	900	Whse.		250	450/550
1	825	Whse.		250	95/190
1	600	Al. Ch.		250	400/800
1	500	Whse.	CC-216	600	300/900
1	500	G. E.	MCF	600	300/900
2	450	Whse.		550	415
1	200	Whse.	CB-511.3	250	400/800

A. C. MOTORS—3 Ph. 60 Cy.

SLIP RING

Qu.	H.P.	Make	Type	Volts	Speed
1	1500	G. E.	MT-498	2300	360
1	1500	ABB		2300	720
1	1200	G. E.	MT	2300	275
2	1000	A. C.	Mill	2300	240
1	1000	G. E.	MT-452	2200	321
1	500	G. E.	M-574Y	6900	900
1	500	Whse.	CW	550	350
1	450	G. E.	IM	440	720
1	400	Whse.	CW-960A	440	1170
1	400	Whse.	CW	440	514
1	400	Whse.	CW-1218	2200	435
1	350	G. E.	MT-442 Y	2200/4000	253
1	350	G. E.	IM-17A	440/2200	720
1	260	G. E.	MT-424-Y	4000	257
1	250	G. E.	MT-559S	2200	1800
1	250	Al. Ch.		550	600

SQUIRREL CAGE

2	650	G. E.	FT-559BY	440	3570
2	450	Whse.	CS-1420	2300/4150	354
1	300	Whse.	CS	440	1170
1	200	G. E.	IK-17	440	580
3	200	G. E.	KT-557	440	1800
1	150	Whse.	CS-856S	440	880
1	150	Whse.	CS	440	580
1	150/75	G. E.	IK	440	900/450
2	125	Al. Ch.	ARW	2200	1750

SYNCHRONOUS

1	4350	C. W.	3501-8L	13800/6900	514
2	3500	G. E.	TS	2300	257
2	2100	G. E.	ATI	2300	360
2	1750	G. E.	ATI	2300	3600
2	2000	Whse.		2300	120
3	735	G. E.	ATI	2200/12000	600
1	720	G. E.	TI	2300/4600	720
1	500	Ideal	SM	2300/4160	1800
1	500	Whse.		440	900
1	450	Whse.		2200	128.5
1	450	Whse.		2200	450
1	400	G. E.	TS	2200	400

M-G SETS—3 PH. 60 CY.

Qu.	K.W.	Make	RPM	D.C. Volts	A.C. Volts
2	2000/2400	G. E.	450	250/300	2300/4600
2	2000	G. E.	450	600	2300/4600
1	2000	G. E.	500	25cg 660	11000
2	2000	G. E.	514	600	6600/13200
1	1800	G. E.	720	600	6600/13200
1	1500	C. W.	514	30/115	4000/13000
3	1000	G. E.	720	600	2300/4600
1	1000	G. E.	900	260	6600
1	1000 (3U)	G. E.	900	250	2200
1	750	C. W.	514	30/115	2300
1	600	G. E.	720	250	440/2300

TRANSFORMERS

Qu.	KVA	Make	Type	Ph.	Voltages
1	5000	Whse.	OISC	3	3300x2640
1	2500	Whse.	OISC	3	26400/13200x46
3	2000	G. E.	HVDDJ	1	66000/13800
1	1500	G. E.	HT	3	13200x230
3	1000	G. E.	HTDDJ	1	2400x480
6	1000	Wagner	OISC	1	13200x46

FREQUENCY CHANGER SETS

Qu.	KW	Make	Freq.	Voltages
1	12500	Whse.	60/25	13200/13200
1	3000	G. E.	60/25	2300/2300/4000
2	2500	G. E.	25/62.5	2300/2300
1	1000	G. E.	25/58.3	4400/2300
1	500	Al. Ch.	2560	11000/2300

TURBO GENERATORS

Qu.	KW	Make	Desc.
1	4000	G. E.	Condensing 425—750 F. T. T. Surface Condenser 3/60/2300/4000 V Direct conn exciter.
1	1500	Whse.	Auto-extraction 190 lbs.—600° F.T.T. 60 lb. extraction 3/60/240 V. Dtv. conn. Exc.
1	1000	Moore	Auto-Ext. Cond. 175/200# I.S.P. 5/20# G. Ext. Surface Condenser—3/60/2300.
1	1000	G. E.	Non-condensing 175/200 lbs. I.S.P. 5/20 lbs. G.B.P. 480/3/60.
1	750	G. E.	Condensing 265 # I.S.P. 440V. 3 ph. 60 cy.—New—1944
1	750	Whse.	—Non-condensing 1 5/ I.S.P. 40# B.P. 750 Kw. 280 V. D.C.

BELYEA COMPANY, INC.
43 Howell St., Jersey City 6, N. J.

NOW IS THE TIME TO BUY....

"Certified Rebuilt" Motors and Generators

HIGHEST QUALITY . . . REDUCED PRICES

Check with WAGNER *First*

A. C. GENERATORS — 60 CYCLE

KVA	Mfr.	Type	Volts	Speed
1000	Whse. syn cond		4000/2300	900
625	Gen. Elec.	ATB	2300	450
600	Gen. Elec.	ATB	480	900
625	El. Machy.	Late	240/480	1200
485	Allis Ch.	1 brg.	480	400
350	El. Machy.	1 phase	480	1200
312	Gen. Elec.	ATB	240/480	600
275	G. E. 25 cycle	ATI	480	750
225	El. Machy.		480	720
225	Gen. Elec.	ATI	240/480	900
150	Allis Ch.		240/480	1200
150	Gen. Elec.	ATB	2300	900
150	Whse.		2300/480	600
125	El. Machy.	Syn.	240/480	1800
125	Gen. Elec.	ATB	240/480	900
112	Gen. Elec.	ATB	240/480	900
75	El. Machy.		2300	900
56	G. E.	ATB	240/480	1200
25	Whse. b.b.	1 phase	120/240	900
10	Kato b.b. New	3 phase	127/220	1800

LOW VOLTAGE M-G SET

Whse. 3636 amp. 20/55 V DC gen. w/synch. motor 220/440 V. 720 RPM and exciters.

D. C. GENERATORS

KW	Mfr.	Type	Volts	Speed
300	Al. Ch.	MECW	125/250	1200
250	Allis. Ch. b.b.	EW	250	1200
250	Gen. Elec.	MPC	250	600
200	Gen. Elec.	RC	250	1150
150	Gen. Elec. b.b.	CDM	250	1500
125	Whse.	SK	250	1450
105	Century b.b.	1500 amp.	70	1200
100	Allis Ch.	E	125	1200
100	Allis Ch.	E182	250	900
100	Delco b.b.	Mar.	125/250	1200
75	Cont. b.b.	D109X	125	1150
75	F. M. b.b.	DH	125	1800
75	G. E. b.b. (2)	CDM135	125	750
75	Whse.	SK	250	900
75	Columbia b.b.		120/240	1450
60	Allis Ch.	E147	250	900
60	Whse. b.b. (2)	SK121	300	1200
50	Cr. Wh. b.b.	CCD	250	1800
50	Reliance	T	250	1150
40	Gen. Elec.	CD103	250	1500
40	F. Morse b.b.	DH	125	1800
40	Gen. Elec.	RC	600	1750
25	Whse.	SK93	125	1750
25	C. W. b.b. (2)	CCD	250	1200
20	Gen. Elec.	RC	125	1150

A. C. MOTORS — 60 CYCLE

HP	Mfr.	Type	Volts	Speed
750	G. E.	Synch.	2200	514
600	E. M.	Synch.	480	1200
550	G. E.	Sq. Cage	2200	1800
500	G. E.	Sq. Cage	4000	1800
500	G. E.	Slipring	2200/440	450
500	G. E.	Synch.	440	900
450	Allis Ch.	Synch.	480	400
400	Whse.	Sq. Cage	2200	514
400	G. E.	Synch.	440	450
400	Allis Ch.	Sq. Cage	2200/440	1200
350	Whse.	Slipring	2200/440	600
350	Whse. (2)	Slipring	2300	450
350	G. E. TEFC	Sq. Cage	2200/440	3600
300	G. E. (2)	Slipring	2200/440	720
300	El. Machy	Synch.	220/440	360
300	Al. Ch.	Sq. Cage	2200/440	720
300	Whse.	Synch.	2200/440	600
300	Al. Ch.	Slipring	2300	514
300	G.E.	Slipring	440	360
250	G.E.	Synch.	220/440	720
250	Whse. (2)	Sq. Cage	2200/440	1200
250	L. A. (2)	Sq. Cage	2200	1800
225	G. E.	Synch.	220/440	900
200	Allis Ch.	Slipring	440	450
200	Gen. Elec.	Sq. Cage	2200/440	720
200	Cr. Wh.	Sq. Cage	220/440	3600
200	Whse.	Sq. Cage	2200/440	900
200	G. E.	Slipring	220/440	600
200	E. M.	Synch.	220/440	1200
200	G. E.	Slipring	220/440	360
200	Whse.	Sq. Cage	220/440	1800
200	E. M.	Synch.	220/440	514
200	Wagner	TEFC	2200	1200
175	G. E. (2)	Synch.	220/440	720
175	Whse.	Synch.	220/440	360
150	Whse.	Sq. Cage	220/440	900
150	G. E. TEFC	Sq. Cage	2200	3600
150	Allis Ch.	Slipring	2200/440	720
150	G. E.	Synch.	220/440	450
150	Allis Ch.	Slipring	2200/440	720
150	G. E. (2)	Sq. Cage	2200/440	720
150	G.E.	Slipring	220/440	450
150	Allis Ch.	Sq. Cage	2200/440	1200
150	Rel. b.b.	Sq. Cage	220/440	1800
150	Allis Ch.	Sq. Cage	440	450
125	Rel. TEFC	Sq. Cage	220/440	1800
125	G. E. (2)	Slipring	220/440	600
125	G. E.	Slipring	220/440	450
125	E. M.	Synch.	220/440	1800
125	Allis Ch.	Slipring	220/440	900
100	G. E.	Sq. Cage	220/440	600
100	Burke b.b.	Synch.	220/440	1800
100	G. E. New	Slipring	220/440	1200
100	G. E.	Slipring	220/440	900
75	G. E. TEFC	Sq. Cage	220/440	600

48 Years of Service to American Industry

D. C. MOTORS

HP	Mfr.	Type	Volts	Speed
500	Allis Ch. b.b.	EW	250	1000
300	Gen. Elec.	MPC	250	500
300	Allis Ch. b.b.	MCF	600	300/700
200	G. E. (2)	RC59	230	850
150	Whse.	SK-201	230	300/900
100	G. E. dyna.	TLC-50	250	1050/4000
100	Allis Ch.	E182	230	600/1200
75	F. Morse b.b.	DH-140	115	1600
75	Whse.	SK170	230	635
75	Whse.	SK173	230	300/1200
50	Reliance	310T	230	850
50	Reliance b.b.	651T	230	750
50	Cr. Wh. b.b.	FH	230	1750
50	Whse.	SK185	230	300/900
40	Whse.	SK143	230	600/1500
40	Reliance	651T	230	350/1000
40	Allis Ch.	E-121	230	1750
40	Gen. Elec. (2)	CD103	230	1150
40	Gen. Elec.	RC32	550	1200
40	F. Morse b.b.	DH 120	115	1750
30	Imperial b.b.	D69	230	400/1600
30	Star b.b. (3)	6B	230	1750
25	Star b.b.	5B	230	1750
25	L. A. TEFC	RNA	230	850
25	Whse.	SK150	230	300/1200
25	Gen. Elec.	CD105	230	575/1720
25	Whse.	SK100L	230	1150
20	Century b.b.	DN326	230	3500
20	G. E. series	CO-1826	230	875

MOTOR-GENERATOR SETS

KW	Mfr.	Input V	Output V
1000	G.E.*	6600 AC	600 DC
500	Whse.*	2300-AC	250 DC
300	G. E.*	440 AC	250 DC
300	Allis Ch.	2200/440 AC	125/250 DC
250	Allis Ch.	2200/440 AC	250 DC
200	Whse.* (2)	220/440 AC	55 DC
200	G.E.*	220/440 AC	250 DC
200	Gen. Elec.*	220/440 AC	125 DC
150	Whse.	2200/440 AC	275 DC
105	Century b.b.	220/440 AC	70 DC
100	G. E.*	2200/440 AC	125 DC
100	Allis Ch.	220/440 AC	250 DC
100	Delco b.b.	220/440 AC	125/250 DC
80	Star* b.b.	220/440 AC	240 DC
60	Gen. Elec.*	220/440 AC	60 DC
60	Whse. (2)	220/440 AC	300 DC
50	Gen. Elec.	220/440 AC	125 DC
50	Cr. Wh. b.b. (3)	220/440 AC	240 DC
40	G. E. (2)	220/440 AC	250 DC
40	Gen. Elec.	220/440 AC	600 DC
30	F. Morse b.b.	220/440 AC	24 DC
25	Whse.	220/440 AC	125 DC
25	Gen. Elec.	220/440 AC	250 DC
18	Gen. Elec.	220/440 AC	125 DC
15	El. Prod.	220/440 AC	40 DC
15	Star b.b.	220/440 AC	250 DC

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For over 43 years CHICAGO ELECTRIC has been of service to industry . . . furnishing modern electrical power equipment thoroughly rebuilt and fully guaranteed at substantial savings over new equipment. CHICAGO ELECTRIC's modern plant houses one of the nations largest stocks of guaranteed rebuilt power equipment; ie

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- GENERATORS
- M.G. SETS
- FREQUENCY CHANGERS
- ROTARY CONVERTERS
- VARI-VOLT DRIVES
- ENGINE GENERATORS
- TRANSFORMERS
- CONTROLS

plus a big selection of allied equipment such as HOISTS, CRANES, AIR COMPRESSORS, FANS, BLOWERS, REDUCERS, BOILERS and PUMPS . . . so, whatever you need and whenever you need it . . . be sure to check with CHICAGO ELECTRIC first!

SLIP RING MOTORS

3 phase, 60 cycle, 220 or 440 volts
*(2300 volts, or higher)

H.P.	Make	Type	Speed
2000	*G. E.	MT-12	600
1500	*G. E.	MT-30	240
1250	*Westg.	CW	600
1000	*Westg.	CW	250
800	Al-Ch.	ANY	600
700	*Al-Ch.	ANY	720
600	*G. E.	MT-422	600
500	*Al-Ch.	ANY	600
500	Westg.	CW	350
400	Al-Ch.	3-brg.	450
400	*G. E.	MT-412	450
300	*G. E.	IE-15A	1800
300	*G. E.	MT-410	450
250	Westg.	HF-15H	600
200	*Westg.	CW	1200
200	G. E.	IK-15B	900
200	G. E.	IM	600
150	Cr. Wh.	50-R	1800
150	G. E.	MT-549	1800
150	Westg.	CW-772C	1200
125	G. E.	IM-15A	600
100	G. E.	IT-13A	1800
100	Al-Ch.	ANY	900
100	G. E.	IM	600
100	G. E.	IM	450

PUNCH PRESS MOTORS

NEW—3/60/220-440 Volt
High Torque—Hi Slip

H.P.	Make	Type	Speed
60/45	G. E.	KR-6325	1090/790
60	Westg.	CS-752-C	1060
60	Westg.	CS-857-C	1085
50	Westg.	CS-505	1060
50	Imperial	E-1584	1090
40	Reliance	AA-B-505	1035
40	Imperial	E-505	1080
40	Westg.	CS-505	1070
40	Westg.	CS-505	1090
30	L.-Allis	OK-445	1080
30	G. E.	KR-445	1065
25	Reliance	AA-C-504	1100
20	Imperial	E-405	1080
15	Imperial	F-444	1090

MOTOR-GENERATOR SETS

1000(3u)	Westg.	11000	137/275
500	Westg.	2300	137/275
500	Westg.	2300	275
450(3u)	G. E.	2300	125/250
400	A. C.	2300	120/240
300	G. E.	2300	250
200	G. E.	2300	250
200	Westg.	4160	280
200	Ridgeway	2300	250
170	G. E.	440	125
150	G. E.	2300	125/250
150	G. E.	4000	250
150	A. C.	2300	275
150	G. E.	440	275
100	Westg.	440	125
100	Elec. Mach.	440	125
100	Ridgeway	2200	275
100	G. E.	240	250
100	G. E.	440	125
90	G. E.	440	60
75	G. E.	440	125
60	Westg.	2300	125
60	A. C.	2300	125
50	Reliance	440	250
50	Westg.	240	125
40	G. E.	440	125
40	G. E.	440	250
35	Westg.	2300	150
30	G. E.	440	125
30	Westg.	2200	125
30	Cr.-Wh.	440	250
20	Bogue-GE	550	250
20	Bogue-G.E.	220/440	250
15	Westg.	220/440	250

SPECIAL
GEAR MOTORS

2—30 H.P. Westinghouse, Type CS-404, 3/60/220-440/TEFC, 1800 rpm with Falk Class 2-9.394 ratio reducer —190 rpm output.

SQUIRREL CAGE MOTORS

3 Phase, 60 Cycle, 220 or 440 Volts
(*2300 volts or higher)

H.P.	Make	Type	Speed
1500	*Westg.	CS	1200
800	*Westg.	CS-1485	1800
700	*Westg.	CS	1200
500	*Al-Ch.	6316-8W	1800
500	G. E.	KT-424	450
400	G. E.	KF-559	3600
400	G. E.	KT-424	360
300	Al-Ch.	AN	1750
300	*G. E.	K-6344Y	1200
300	G. E.	K-6353 TEFC	720
250	*L.-Allis	OEX 148	720
250	G. E.	IK-17A	600
200	*G. E.	FT-549Y	3600
200	*G. E.	IK-13B	1800
200	*Al-Ch.	AN	720
200	Al-Ch.	ARWWT	585
200	*Westg.	CS	600
200	G. E.	IK-17	600
200	G. E.	K-6352	514
150	Al-Ch.	AR	3600
150	G. E.	IE-13A	1800
150	G. E.	IE 13B	1200
150	*Westg.	CS-812 S TEFC	1200
150	Westg.	CS-854	900

D. C. MOTORS 230 Volt

H.P.	Make	Type	Speed
250	Westg.	SK-201	650
250	Westg.	SK-220	450/600
250	G. E.	MPC-4	700
200	Cr. Wh.	CM	500
175	G. E.	ELC	750
100	G. E.	MPC	400/800
100	G. E.	RC-34	2500
100	G. E.	RC-19	575
100/150	G. E.	MCF	380/1000
50	G. E.	MCF	250/100
50	G. E.	RC-21B	1700
50	Cr. Wh.	CMC	700/1100
50	G. E.	DCC-204	650
35	Westg.	SK-150	350/100
30	Cr. Wh.	CCM-504	450
30/40	G. E.	CD-115	500/1500
25	Westg.	SK-1096	1100
25	G. E.	RC-32	800
25	A. C.	E-130	775

CHICAGO *Electric Co.* 1320 WEST CERMAK ROAD, CHICAGO 8, ILL.

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M-G SETS

Electrical Equipment of All Kinds

Rebuilt and Guaranteed
LOWEST PRICES

LOW VOLTAGE MOTOR GENERATOR SETS

1—Hobart, 1000/500 amps, 6/12 volts
1—Chandy, 5000/2500 amps, 6/12 volts
1—Ridgeway, 4500 amps, 30 volts
1—Chandy, 3000/1500 amps, 24/48 volts
1—G.E., 600 amps, 30 volts

GEAR HEAD MOTORS

5—Link Belt, 20 HP, 74 RPM, TE
4—G.E., 40 HP, 561 RPM, TE
5—G.E., 60 HP, 427 RPM, TE

AC & DC MOTORS—PUMPS
AIR COMPRESSORS

LARGEST STOCK IN MIDWEST

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1563 KVA 3/60/480 v. GE. TURBO unit "bleeder"

625 KVA Al Chal TURBO unit, non-cond. 3/60/480/240 v.

250 KVA (2) Wghse 3/60/480/240 v—7 cyl. DIESEL units

200 KVA (2) GE. 480/240 v—Buckeye 6 cyl. Diesels

125 KVA GE 3/60/440/220 v—Sterling GASOLINE unit

800 HP (2) B&W 250# BOILERS

680 HP (4) B&W 260# BOILERS

500 HP (3) B&W 160# low head BOILERS

300 HP (2) Keeler 250# PACKAGE BOILERS

300 (2) B&W 160# low head BOILERS

250 HP (2) B&W 225# low head BOILERS

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65 FOOT SPAN

Northern Engineering Company. Fish belly fabricated—travel motor—trolley motor—30 ton hoist—15 ton auxiliary hoist motor. All 230 volt DC motors—mfg. by G.E.—cab controlled with G.E. controls.

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LIKE NEW

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PORTION OF ENGINE REMANUFACTURING FLOOR AND ONE OF THE ENGINE TEST STANDS AT OUR SAUSALITO, CALIF. PLANT

A PARTIAL LIST OF OUR INVENTORY

KW	MAKE	MODEL	HP	RPM
1180	Worthington	SEH-8	1685	360
1136	Fairbanks Morse	38D	1600	720
1100	General Motors	16-278A	1600	720
750	General Motors	12-567	1080	720
700	Worthington	EE-8	1000	327
600	General Motors	12-567	900	600
*500	General Motors	8-278A	750	720
*500	Alco	6-12½x13T	750	600
500	General Motors	8-567	720	720
*400	Ingersoll-Rand	S-8	600	720
*400	Sterling	VDS-8	600	1200
*350	Baldwin	VO-6	510	450
320	Superior	60-S-6	460	450
*320	Enterprise	DSG-6	460	450
300	General Motors	8-268A	450	1200
200	General Motors	8-268A	350	900
*160	Buckeye	80	240	600
150	Fairbanks Morse	338-17	225	300
*150	Worthington	CC-4	225	450
150	Ingersoll-Rand	S	255	600
100	General Motors	3-268A	150	1200
60	General Motors	6-71	90	1200

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STANDARD AND SPECIAL VOLTAGES AS REQUIRED
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2—750 HP Superior 8 cylinder, 400 RPM, 500 KW Elec. Mchy. 3/60/440 volt generators & auxiliaries.

3—300 HP Buckeye 6 cyl. 600 RPM 4 cyc. 200 KW Ideal 3/60/480 volt generators. Complete plant. New 1947.

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1—2000 KVA — 3-60-33000-4160Y Westinghouse type CPS Westinghouse self-contained substation.
1—450 KVA—3-60-13200-115/230 V. GE substation.
4—100 KVA—3-60-2400-208/120 V pyranol GE transformers with 225 A3 pole airbreaker mounted on case.
700 & 450 HP—180 rpm—4160 V UNUSED syn. motors.

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Iron Fireman . . . in original crate. 2400# per hour capacity. 24 PS pneumatic overfeed spreader type. To be set on combination with one 84" x 20' Combustion Engineering Co. 311 HP NuWay horizontal return tubular boiler. Complete with 1500# feed hopper agitator and boiler operating controls.

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COMPLETE POWER PLANT

4—1285 HP B. & W. Boilers, rated 225# psig steam, A.M.S.E. code, lower tubes retubed in 1952, C/W underfed stokers, boiler feed pumps, blowers, Cochrane Heater, pipes & valves, etc.

1—15,000 KVA G. E. Turbo-Gen. Set, type ATB-4, 3 ph., 60 cy., V 9000, 1800 RPM, direct connected to a Curtis Condensing Turbine, 200# psig steam, C/W 20,000 sq. ft. C & H Wheeler Surface Condenser, Condensate Pump, Switchboard, etc.

1—50 ton Whiting Power House Overhead Crane with 10 ton aux. hoist, 45' span, 3/440/60, operator cab.

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ALLIS-CHALMERS OUTDOOR SWITCHGEAR

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Type ODJ 5 kv, 50,000 v Interrupting Capacity, Draw Out, 125 v DC operated—was used for 2300 v service.

Eleven (11) Cubicles; 90" high. 20" wide, 60" deep. Consisting of:
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EVergiade 4-4511

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1 to 1000 KW, AC & DC
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Boilers	Motor Generator Sets	Oil & Air Circuit Breakers
Transformers	Frequency Changers	Feeder Voltage Regulators

Your inquiries stating your needs will receive our careful and prompt attention

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MOTORS · MG SETS

Qty.	HP	Make	Voltage	Speed
12	3000	West.	525/600	600 RPM
28	1500	West.	525/600	600 RPM
32	1500	Al. Ch.	525/600	675 RPM
4	1200	Al. Ch.	525/600	650 RPM
2	900	Elliott	230	300/195 RPM
3	800	West.	525/600/600/900	RPM
1	650	Cr. Wh.	230	475/720 RPM
1	500	West.	230	250/500 RPM
1	400	G.E.	230	180/360 RPM
7	400	Elliott (new)	230	400/800 RPM
5	400	West. (new)	230	375/750 RPM
2	350	Cr. Wh.	230	400/800 RPM
1	200	Cr. Wh.	230	500/750 RPM
1	200	Cr. Wh.	230	375/750 RPM

All motors designed for mill reversing service.
Smaller sizes also in stock.
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100—2000 KW Capacity
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APPARATUS EXCHANGE Two Rector St., New York 6, N. Y.

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18 NEW TURBINES

4 horizontal, 14 vertical, Westinghouse

Driving forced draft blowers—capacities ranging from 39000 to 56000 CFM and 16" to 24" pressure. Steam pressures 360 to 575#, back pressure 10#.

Will sell turbines separately if desired. *Price reasonable.*

Also—1—250 KW GE turbo generator unit, 3 phase, 60 cycle, 440 volt. Used one year.

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1—Kennedy Van Saun 3' D x 6' L Contin. Steel Lined Ball Tube Mill.

1—Allis-Chalmers 6' D x 16' L Contin. Steel Lined Ball Mill.

Also 2 Henry Vogt 1000 HP Boilers and 1 Vogt Waste Heat Boiler 178# WP, 248 HP.

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O'Brien Offers—

MOTOR GENERATOR SETS

1—500 KW Crocker Wheeler CCD, 250 volt 720 RPM with 750 KVA Cr. Wh. Syn. Motor 3/60/2300 V. A.C. & D.C. Panels.
1—300 KW Ridgway 250 V. 3/60/2300/1200 rpm
1—300 KW West. 3 wire 125/250 Volt 1200 RPM Generator (1938 year). Can furnish with suitable motor. Advise Requirement.
2—250 KW Burke 125 V. 435 KVA Syn. M.D. 3/60—any voltage
2—180 KW G.E. Frequency Changers 60/120 cycle
1—150 KW G.E. Type MPC—250 Volt 1200 RPM 3/60/2300/200 H.P. Syn. Motor Drive A.C. & D.C. Panels
1—100 KW G.E. RC 17, 125 v. 3/60/220/1200 rpm
1—100 KW Electro Dynamic 200 V. 3/60/220/1200 B. Brg. Sq. Cg. Sep. Excited.
1—100 KW Al. Ch. 250 V. 1200 RPM 150 HP. Syn. Mtr. 2/60 or 3/60 any voltage.
1—100 KW West SK Comp'd 125 V., 150 HP West syn. 3/60/440/1200 rpm.
1—75 KW Burke 250 V. 900 RPM 113 H.P. Burke—Syn. M.D. 2 or 3 ph, any voltage.
2—70 KW Century, 1000 amp, 70 volt, 3/60/220/440
1—62½ KW 125 volt Hertner, 1200 rpm, 100 HP Sq. Cg. 3/60/220
2—50 KW GE 500 Volt DC, 75 HP, 3/60/40/1200 RPM.
1—18 KW Optimus, 3000/1500 amp 6/12 volt
1—17 KW West., 28 v. 60 amp 3/60/220
1—6 KW G.E. 6 v. 100 amp, 3/60/220

DIESEL GENERATOR SETS

3—625 KVA Inger. Rand, 3/60/480/720 rpm
375 KVA GM 8-268 Diesel 3/60/440
300 KW GM 8-268 Diesel 125/250 V. D.C.
187 KVA GM Twin Diesel 3/60/220 New
125 KVA Waukesha Diesel 3/60/220-440
100 KW Buda Diesel 250 V. D.C.
100 KVA Murphy Diesel 3/60/220-440
65 KVA Buffalo Gas 3/60/220
56 KVA Climax Gas 3/60/220
45 KVA Chrysler Diesel 3/60/220
30 KVA LeRoi Gas 3/60/220
25 KVA LeRoi Gas 1/60/120/240
18.75 KVA Hercules Diesel 1/60/120/240

BOILERS

1—25000# Foster Wheeler 250 lb. WT Package Oil & Gas Comb. New
1—60,000# Erie Stoker New 160 psi
1—610 HP Keeler 3 Drum Bent Tube Pulverized Coal 32,000 lb. 1 HR 250 lb. W.P.
1—350 Cleaver Package Heavy Oil 150 lb. W.P.
1—300 HP Keeler CP 300 lb. Oil
1—250 HP Ames Package Type (1948) 150 psi
2—200 H Springfield Sec. H. dr. 400 psi
1—188 HP CP Keeler W.T. 1942 Oil 160 lb. W.P.
1—150 HP CP Keeler W.T. 1947 Oil 150 lb. W.P.
1—100 H Verticle Hand Fired 100 lbs. Working Pressure
1—100 HP Clayton Forced Recirculation Compact Self-Contained and Fully Equipped for Operation 160 lb. W.P.
1—35 HP O and S Scotch Hand Fired 100 lbs. W.P.
1—25 HP Dowtherm Vaporizer
5—18 HP Red-Line New Horizontal Oil Fired 150 lbs. W.P.

ELECTRIC MOTORS

QU.	HP	Make	Type	Volts	Speed
1	1500	Al. Ch.	sl. rg.	2300	514
1	1000	G.E.	K	2300	1800
1	1000	West.	CW	2300	450
1	700	West.	CS	2300	1800
1	500	Al. Ch.	Syn.	2300	212
1	500	AC	ARX	2300	1800
1	500	West.	CS	6600/2300	514
1	450	A.C.	ANY	2300	600
1	400	West.	CW	440	514
1	400	G.E.	Syn.	2300	450
1	350	G.E.	MT18	2300	400
1	200	West.	CS	2200	1800
1	200	G.E.	IM	440	600
1	125	West.	Syn. 3 brg.	550	600

"Everything from a Pulley to a Powerhouse"

TURBO GENERATORS

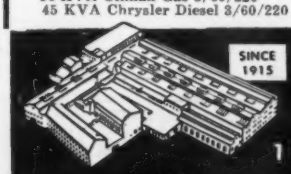
1—1250 KVA DeLaval Non-Cond. 3/60/2300. New 1940 240 psi 50 lb. B.P.
1—938 KVA GE-Terry Aut. Extr. 3/60/480 150 psi. 20 lb. B.P. Surf. Condenser 1934
1—780 KVA G.E.-Moore 3/60/2300/3600 RPM Non-Cond. 180 PSI 35 lb. B.P. New 1936.
1—187 KVA West. Non-Cond. New 1930 3/60/440 110 psi 10 lb. B.P.
1—94 KVA Worthington Non-Cond. 3/60/220 140 psi 5 lb. B.P.
1—50 KVA 1200 rpm Century generator (New 1949) Dean Hill Non-condensing turbine
1—75 KW G.E. Non-Cond. D.C. 125 volt.

AIR COMPRESSORS

1—1600 cfm IR PRE-2 Syn. Mtr. Dr. 3/60/2300—100 psi.
2—1300 cfm IR-PRE-2 3/60/2300—100 psi
1—978 CFM Sullivan 13x13x8, 45 psi.
1—670 CFM Chicago OCE Syn Mtr. Dr. 3/60/2300
2—660 cfm I R-XRE 3/60/480—100 psi
1—396 CFM Sullivan WL60 125 psi Direct Drive 75 HP 3/60/440
1—368 CFM Chi. NSB, 12x10, 100 psi.
1—371 CFM Schramm 7¼x5x4, 100 psi
1—173 CFM Chicago NSB 100 psi

OISC TRANSFORMERS

Qu.	KVA	Make	Pri. V.	Sec. V.	Phase
3	2000	G.E.	13200	230/460	1
3	1000	GE	13200	2300	1
1	1100	West.	4160	440	3
1	750	O'Brien (New)	13200	480	3
3	667	Al. Ch.	33000	2300	1
3	500	West. Dry	33000	2300	1
3	500	West.	22000	460	1
1	500	Gregory	4160	440	3
3	500	GE	13200	2300	1
3	400	GE	2400	480	1
3	333	West. Dry	2400	480	1
3	333	West. (1945)	33,000	480	1
3	333	Pitts.	33000	2300	1
3	333	G.E.	13800	240/480	1
3	250	Al. Ch.	13,200	115/230	1
2	250	West. Dry	13800	230	1
3	150	West	2300	230/115	1
3	150	Dry	2300/4160	230/460	1
3	100	Dry	2300/4160	230/460	1
3	100	West.	4160	240/480	1
3	45	West.	4160	120/240	1



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'BOILERS'

- 1—220 HP Heine Water Tube 160#
- 2—72 x 18 H. R. T. 150#
- 3—66 x 18 H. R. T. 125#
- 1—125 HP Kewanee Firebox 125#
- 1—Kisco 60 HP Package—Late 125#

(ALL CODE BOILERS)

NELSON Machinery & Boiler Co.

GREEN BAY, WISCONSIN

Tel: 5-5383

1000 KW DIESEL GEN. SET

6 Cylinder, Air Start, Bosch Inj. System, Nelseco Diesel Engine, 300 RPM, direct coupled to: General Electric AC, 1000 KW, 3/60/2400 Volts, including: Starting Auxiliaries, Switchboard, and Spare Parts. Overhauled, ready to ship.

Various other makes and sizes in stock, AC & DC Units.

ALJON ELECTRIC DIESEL CO.

904-10 Pacific St., Brooklyn 38, N.Y.

STerling 3-6515

M-G SETS!

1—500 KW, 240 V D.C., Whse. M-G Set, 900 RPM, Syn. Drive, 3/60/2200. Ser. 4979926 with magnetic reduced voltage starter.
3—400 KW—270 V DC G.E. 3/60/2300/900 RPM Syn. Drive. 3 Brg. Complete w/AC & DC panels. Ser. #4,098,425-26-65.
1—200 KW, 125 V D.C., Type PED, Ser. 576881. E-M Set, 900 RPM, Syn. drive. 3/60/2300 (4160.)

TURBO-GENERATOR

1—750 KW, Elliott AC Generator, Frame 3232, 3600 RPM, 3/60/180. Elliott Turbine, inlet 200% ga. 112 deg. F. superheat. 28" hg. vac. exhaust. Complete with accessories.

SYNCHRONOUS CONDENSER

1—1000 KVA, Allis-Chalmers, 3 phase, 60 cycle, 2300 volts, 600 RPM

SYNCHRONOUS MOTORS

1—200 HP, F-M, 300 RPM, Type TZO, Frame 5
1—200 HP, E-M, 900 RPM, Type PED, 2300/4160V
1—150 HP, G.E., 277 RPM, Type ATI, 2300V

MOTORS

Amt.	HP	Speed	Make	Type	Frame
3	250	600	G.E.	KT568 (2200V.)	
1	150	1800	Whse.	CS(2200V.)	8718
1	150	1800	A-C	2200V.	
1	150	900	G.E.	I-K(2200V.)	15
1	125	1800	Whse.	CS	
1	100	1800	Whse.	CS	663C
1	100	1200	Whse.	CS	752C
1	100	900	G.E.	MT356 Slpr	
1	100	900	A-C	2300V.	

BENSON-WILIMZIG, INC.

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BOUGHT AND SOLD

We carry a large stock of rebuilt and guaranteed transformers, and invite your inquiries.
Custom-built transformers and coils manufactured to your specifications.
Expert Repair Service—all makes and sizes of transformers rewound, repaired and redesigned.

Ask for our price schedule

THE ELECTRIC SERVICE CO., INC.

5331 Hetzel St. Cincinnati 27, Ohio

40 Years' Dependable Service

37 Years Dependable Service

SLIP RING MOTORS 3-Ph., 60 Cy.

H.P.	Volts	Make	Speed
600	2200	Whse.	450
500	2200/4000	G. E.	900
450	440	Whse.	514
450	440	Whse.	720
300	2300/440	G. E.	720
300	440	G. E. (hoist)	600
300	2200	G. E.	360
300	440	Whse.	3600
250	440/220	Whse.	600
250	550/440	G. E.	1200
200	440/220	Whse.	514
150 (2)	440/220	G. E.	720
150	2200/440	G. E.	600
135	440/220	G. E. (hoist)	600
125	440/220	G. E.	900
125	550/440	G. E.	1200
125	2200	G. E.	600

SYNCHRONOUS MOTORS 3-Ph., 60 Cy.

H.P.	Volts	Make	Type	R.P.M.
400	2200/440	G. E.	ATI	720
375	440/220	Whse.	G	900
350	440/220	El. Machy.	Syn.	1200
300	2300/400	G. E.	TS	720
300	2200/440	G. E.	TS	1200
250	2200/440	G. E.	TS	720
250	440/220	Whse.	HR	277
250	440/220	G. E.	ATI	600
125	440/220	Whse.	HR	400

SQUIRREL CAGE MOTORS

H.P.	Volts	Make	Type	Speed
600	2200	G. E.	FT	3600
500	2200/4000	Elliot	SC	1800
500	2200	G. E.		450
400	2200/400	Whse.	CS	720
300	2200	L. Allis	FS	1800
225 (2)	2200/440	G. E.	KT	1200
200	440	G. E.	IK	720
200	440/220	G. E.	KT	1800
200	2200/440	G. E.	JK	600
200	2200	G. E.	KT	1800
150	440/220	Whse.	CS	900
150	2200	Al. Chal.	AR	1800
150	230	Whse.	CS	1200
150	440/220	G. E.	IK	450
150	440/220	G. E.	KT	720
150	2200/440	G. E.	KT	600

A. C. GENERATORS

1—320 kva, 600 rpm 2300/440/220 V., G.E.
1—300 kva, 900 rpm, 480/220 V., G.E.
1—225 kva, 600 rpm, 220/440 V., G.E.
1—200 kva, 720 rpm, 2200/440 V., G.E. (Ball)
1—187 kva, 1200 rpm, 2260/440 V., Whse.

CIRCUIT BREAKERS

2—2000 amp. GG E., 3 pole, 600 V.
2—1600 amp. ITE, 3 pole, 600 V.
6—FKR-155-28, 600 amp., 15,000 V., G.E.

D. C. MOTORS

H.P.	Volts	Make	Type	Speed
225	230	Whse.	SK	2870
150	230	Whse.	SK	1750
100	230	Whse.	SK	400/1200
96	230	G. E.	CD	1750

MOTOR GENERATOR SETS

KW	Make	Input V., AC	Motor Type	Output V., DC
250	Whse.	2200	Syn.	250
175	G. E.	220/440	Syn.	230
125	G. E.	440/220	Syn.	250/125
100	Al. Ch.	220/440	sq. ca.	240/120
100	Whse.	440/220	sq. ca.	125
75	G. E.	2200/440	Syn.	125
65	G. E.	2200/440	sq. ca.	250

TRANSFORMERS 60 Cy.

1—600 kva, Standard, 13,800-2300 V., 3 ph.
3—500 kva, Whse., 66000—2300 V.
3—333 kva, G. E., 12000—2300 V.
3—200 kva, G. E., 2300—575 V.
3—200 kva, G. E., 11000—2300 V.
3—200 kva, G. E., 4150—480/240 V.
3—150 kva, Al. Chal., 2400—240/480 V.
6—100 kva, Whse., 2400—120/240 V.

only partial listing

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HARRY J. RICE, Pres.
625 ADAMS ST., HOBOKEN 2, N. J.

LAND'S 45th YEAR

MOTORS & GENERATORS, etc.
1 YEAR GUARANTEE
Partial Listing ONLY!

1000 KVA PYRANOL BANK

3—333 KVA GE type H form K2DA —1 ph 60 cycle transformers 13800 volts primary, 460 volts secondary, ser. #6417472—3 & 4.

125 VOLT DC GENERATORS

KW	Make	Speed
200	West.	900
150	Westg.	1200
150	Westg. (3)	900
100	Cr. Wh.	1200
100	E.M.	1200
100	G. E. (2)	900
100	Westg.	1200
100	Westg. (2)	900
75	G. E. (2)	1200
50	Westg. (2)	1150

250 VOLT DC GENERATORS

KW	Make	Speed
2000	G. E.	NEW
1150	G. E.	NEW
750	G. E. (2)	NEW
400	G. E.	NEW
250	Cr. Wh.	1200
200	El. Mchy.	900
150	G. E.	1200
125	G. E. (2)	1200
125	E. D.	1750
100	Delco (4)	1150
75	Westg.	900
75	Cr. Wh.	1150

SYNCHRONOUS CONDENSER

1250 KVA Westg., 480 volts, 1200 RPM, with 15 KW direct connected Exciter. Late modern. Complete.

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L.J. LAND INC.

148 GRAND STREET
NEW YORK 13, N. Y.

Est. 1910 — 44th YEAR

BOILERS

2—250 H.P. Keeler CP, 175# pressure.

1—72 H.P. Titusville Locomotive Return Tubular, 125# pressure.

PUMPS

2—Worthington Duplex Pumps, 12 x 8½ x 12.

JAMES T. CASTLE CO., INC.
311 Ross St. Pittsburgh 19, Pa.

Complete 500 KW Hydro Plant For Sale

Turbine, Leffel LL, vertical shaft, 500 HP, 164 RPM, 30' head. Installed 1938. Direct connected to

Alternator, Electric Machinery Company, Ser. #352908, 625 K.V.A., 2300 volt, 3 phase, 60 cycle, 164 RPM, Weight approx. 30,000 lb. Installed 1914.

Governor, Woodward, #3432, Type HR and Associated Switchboards.

Plant located on the Root River, approximately 2 miles from Lanesboro, Minnesota. Above generating equipment for immediate sale "as is, where is" for $4,800.00.

DAIRYLAND POWER COOPERATIVE
2615 East Avenue South. La Crosse, Wisconsin

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500 HP, 600# Pressure WT Boiler—1946
100 HP, 100# Loco. Type Boiler Oil Fired
84"x20', 250 HP Erie City HRT Boilers
30 HP 125# Clayton & C. Brooks Boilers
300 KW Generator dir. con. to Engine.
6—150; 3—200; 500 KVA Transformers
80x360x25—10 Ton Crane Building
Rohins H.D. Car Shakeout w/motor
H. & P., 6719 Etzel, St. Louis 14, Mo.

FOR SALE:

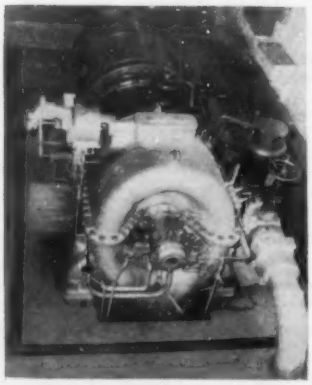
1250 KW Turbogenerator consisting of—

1 Curtis Steam Turbine—1250 KW—3600 RPM Form C—3 Stage—275 lb. steam pressure, Condensing. Manufactured by General Electric Co.

1 AC Generator—2300 Volt—3 Phase—60 Cycle, 80% Power Factor—1250 KW—3600 RPM. Manufactured by General Electric Co.

1 2750 Sq. Ft. Westinghouse Electric Mfg. Co., Surface Condenser.

The above to be sold as is, F.O.B., Foundation at our plant at Perry, N.Y., and to be sold as a complete unit.



ALSO FOR SALE:

1—M.G. SET as follows—

Motor—40 H.P.—220 Volt, 3 Phase, 60 Cycle, 870 RPM, General Electric Co.

Direct connected to DC Generator—Westinghouse Electric Mfg. Co., 125 Volt—360 Amp—850 RPM.

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25000 KVA AUTOTRANSFORMER

General Electric, Type HT, Form DD, 60 cycle, 3 phase serial 4126955, 0.812% impedance, 55° C. continuous, circular coil design, voltage rating—69300 Primary, 66000 Second. KVA rating as a two winding transformer—2500 KVA—with any voltage combination from 66 KV to 2.4 KV.

Some Possible Ratings as an Autotransformer on Standard Voltages

PRIMARY KV	SECONDARY KV	KVA RATING
67	43.8	6500
67	34.4	4650
67	22.9	3450
34.4	22.9	6800
34.4	13.8	3750
34.4	13.2	3700
34.4	12.47	3550
34.4	12.0	3500
22.9	13.8	5700
22.9	13.2	5400
22.9	12.47	5000
22.9	12.0	4750
22.9	8.32	3550
22.9	7.2	3350
13.8	7.2	4750

We Will Rewind This Transformer To Your Specifications

BOILERS
1—350 HP Hedges-Walsh Weidner 225 psig

DIESEL GENERATORS
1—300 KVA Superior YLO—G.E. Gen 400 rpm 2200/440/3/60

TRANSFORMERS—1 PHASE 60 CYCLE
3—3333 KVA 66000 to 33000 & 13200 v.
1—1000 KVA 33000/11000/2300
2—1000 KVA 13800—2300 v.
3— 500 KVA 38100/66000 Y—2300 v.
3— 500 KVA 33000 v.—2300 v.
4— 500 KVA 13200 v.—2300 v.
4— 200 KVA 33000 v.—2300/4160 Y
5— 200 KVA 13200—2300/4160 Y
1— 200 KVA 12000—2300/4160 Y
3— 200 KVA 7620/13200 Y—2300
1— 150 KVA 6600—2300/4160 Y

TURBO GENERATORS
1000 KW West. Cond. 185 lbs 100 SH 3/60/2300
1500 KW G.E. Non-Cond. 140 lbs. 3/60/2300
1000 KW G.E. Non-Cond. 140 lbs. 3/60/2200

PUMPS—BOILER FEED
600 GPM 1220' hd. DeLaval 3550 RPM Requires 250 HP
600 GPM 1220' hd. Conn. 233 HP 3550 RPM 400 lb. pres. DeLaval turbine
400 GPM 1250' hd. Worth. 1750 RPM 5" x 4"

GENERATORS—GAS ENGINE
99¾ KVA 230/3/60 Star Buda with charger
66½ KVA 240/3/60 4 wire Waukesha-Bardco Type C12 truck mounted

SYNCHRONOUS MOTORS
400 HP 1800 RPM 2200 volts Westinghouse .8 PF
300 HP 400 RPM 2200/440/3/60 G.E.

CENTRIFUGAL PUMPS
5200 GPM 55' hd Worthington 18 x 14, 1150 RPM 100 hp required.
5000 GPM 214' hd Pennsylvania 15½ x 14, 1775 RPM 300 HP required.
4375 GPM 100' hd. DeLaval 14 x 12, 1270 RPM
3500 GPM 37' hd DeLaval 12 x 12, 1160 RPM 50 HP required.
3200 GPM 50' hd Gardner Denver 10 x 12, 1160 RPM 60 HP required.

AIR COMPRESSORS
570 CFM 17 x 12, 55 psi, single stage Ingersoll-Rand Type ERI, 85 hp
335 CFM 14 x 10, 100 psi single stage Ingersoll-Rand Type ERI, 100 hp.

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FOR SALE

INDUCED DRAFT UNIT

Motor driven with built in cinder collector. 7½ H.P. 1750 R.P.M. 3 phase, 60 cycle 220/440 Volts. V belt drive. Stack 24 inches in diameter 20 feet long also included. On ground ready for hauling. Used less than three (3) years.

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WE BUY NEW & USED ELECTRICAL SURPLUS

Wire & Cable • Conduit Fittings
Wiring Devices • Switches
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Motors • Transformers, Etc.

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FOR SALE

(5) OIL FIRED B&W BOILERS

75,000 lbs. per hour—11,147 sq. ft. heating surface — 200 lbs. working pressure. Cross drum—sectional header—30 sections wide. IN EXCELLENT CONDITION. LOCATED BALTIMORE, MD.

(2) EX-LIBERTY SHIP BOILERS

24,000 pounds per hour—4890 sq. ft.—225 pounds working pressure. Made by Combustion Engineering Co. Located West Coast.

(3) SCOTCH MARINE BOILERS

225 pounds working pressure. Approximately 17,500 pounds each, per hour.

(4) 300 KW G.M. 8-268A DIESEL GEN.

G.M. diesel generator sets—120/240 volts DC —1200 RPM—1250 amps.—8 cyl. 6½x7—with switchgear.

(6) 300 KW TURBO GENERATOR SETS

120/240 volts DC—Joshua-Hendy turbine—250 lb. W.P. condensing. Suitable for pressures to 440 lbs. at 740°TT. Geared to 1200 RPM. 300 KW Westinghouse 120/240 volt 1250 amp. stabilized shunt generator. With switchgear. Built 1945. Excellent condition.

THE BOSTON METALS CO.

313 E. Baltimore Street
Baltimore 2, Md.
Curtis 7-5050

FOR SALE

2 American Marsh Steam Vacuum Pumps—Size 25" x 16" x 20"—In Perfect Condition. Price: $800.00 ea., F.O.B. Washington, D.C.

S. E. DOCKSTADER, INC.
1025 Brentwood Rd., N.E., Wash'tn 18, D.C.

$ CASH MONEY $

WE BUY ELECTRIC SUPPLIES • MOTORS • TRANSFORMERS • WIRE • CABLE
SEND LISTINGS
ALLIED ELECTRIC COMPANY
Box 1838—1122 Falls Bldg., Memphis, Tennessee

FOR SALE

BY SEALED BID

Opening date 10/4/54, 3:30 PM EST at Lansing, Michigan.

One Westinghouse Turbine Generator, 350 KW, 14 years old and overhauled in 1953. This may be inspected at the Coldwater St Home & Tng School, Coldwater, Michigan. For Bid Forms and complete information regarding description, write to the

MICHIGAN STATE PURCHASING DIVISION,
LANSING 13, MICHIGAN

WANTED

2000 or 2500 K.W. 3 ph. 60-480 V. turbo gen. set for 185 to 200#-0-10# BP also
TWO Packard Model 4M 2500 or TWO Sterling Admiral oil engines.

JAMES K. HOOPER
39 Cortlandt St., N. Y.

WANTED A NON-CONDENSING TURBO GENERATOR IN GOOD CONDITION AS FOLLOWS:

1000 KW at 80% P.F. 2300 Volts 60 Cycles, 3 phases. To carry full load with 100 pound gauge pressure and 15 pound gauge—back pressure and suitable to stand up to 150 pounds pressure.

RANCHO VELOZ SUGAR CO.
Central Constancia, Aguiar 209, Habana, Cuba

FOR SALE

One second hand Strong Scott Coal Pulverizer 1946 Model. Capable of burning 1700 lbs. coal per hour. Unit includes 20 H.P. 550volt 3 phase 60 cycle induction motor which drives both fan and pulverizer. Contact COATS & CLARK INC., Toccoa, Georgia.

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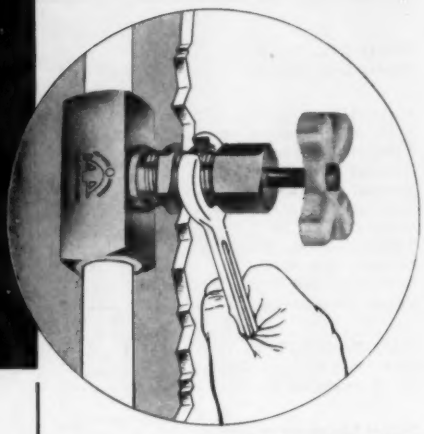
For panel mounting with double female connections.

For panel mounting with male inlet; female outlet.



A quick, trim panel mounting with a twist of a wrench.

Panel mounted in seconds!

Did you know that the best needle valve is also best for panel mounting?

Look at the valves above . . . specifically designed for panel mounting. No holding fixtures are needed. Simply remove the packing nut and one of the holding nuts; slip the stem through the panel opening and reassemble. The valve handle is packed separately to speed up the job — literally done in seconds.

You get a neater installation at lower cost . . . just one more proof that we have thought of everything in the Marsh 1900 series. Note the unduplicated features opposite. Ask for Needle Valve Catalog covering all details.

MARSH INSTRUMENT CO., *Sales affiliate of Jas. P. Marsh Corporation*
Dept. F, Skokie, Ill.

MARSH *Needle Valves*

Standard globe pattern with double female connections.

Standard globe pattern with male inlet; female outlet.

Standard angle pattern with double female connections.

Standard angle pattern with male inlet; female outlet.

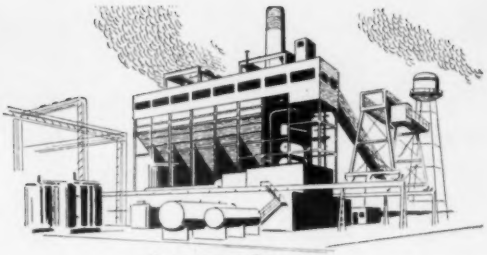
MARSH

The ultimate in Needle Throttling Valves

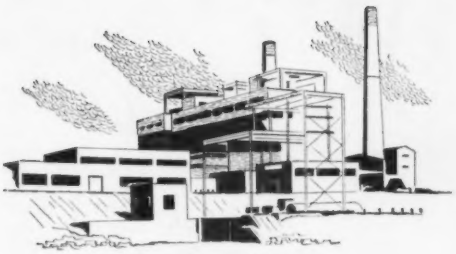
All Marsh Needle Valves — for both panel and standard mounting — share these features that are combined in no other valves.

- **Maximum working pressure: 10,000 psi** — for water, oil, or gas. Equally effective in lower pressure ranges.
- **One piece.** Body and stem-guide are fused into one piece by Marsh "Conoweld" process. No danger of stem leaking or blowing out.
- **Precision machined and ground stem** —of 416 stainless steel. Easier to operate at higher pressures.
- **Finer regulation**—provided by long fine stem threads which also give added strength.
- **Machined from heavy bar stock**— Both body and stem-guide. Sturdiest basic construction known.
- **Deep "Marpak" packing**—longer lasting; easier to renew.
- **Deep throats and thread chambers** —for tight make-up of piping.
- **Handsome appearance**—Electro zinc plated body, set off by sturdy malleable iron handle finished in heavy, attractive, yellow baked enamel.
- **Clear markings.** Bodies marked in accordance with M.S.S. regulations showing size, material, service symbol, maximum pressure.

The standard series is shown opposite.



GOLDSBORO STATION
Total capability 169,000 kw.



LUMBERTON STATION
Total capability 185,000 kw.

WILMINGTON STATION
Total capability 230,000 kw. (est.)

Grinnell piping products have played a vital role in the construction of

7 NEW UNITS IN 7 YEARS

for Carolina Power & Light Company

HERE IS THE RECORD!
(Completion dates)
1949 . . . Lumberton Station, Unit #1
1950 . . . Lumberton Station, Unit #2
1951 . . . Goldsboro Station, Unit #2
1952 . . . Goldsboro Station, Unit #1
1952 . . . Lumberton Station, Unit #3
1954 . . . Wilmington Station, Unit #1
(Scheduled completion date)
1955 . . . Wilmington Station, Unit #2

Main steam line in WILMINGTON plant, fabricated by Grinnell, and supported by Grinnell Model R Constant-Support Hangers.

Since 1949, Carolina Power & Light's modernization and improvement program has been in full swing. Over this 6-year period, 6 new steam-electric generating units have been added to the system, with another scheduled for completion early in 1955. And very significantly, in each of these seven new units, Grinnell Prefabricated Piping and Grinnell Engineered Hangers have been employed, *exclusively!*

This continuous use of Grinnell Piping Products over the years means that Grinnell has successfully passed the most exacting test of all . . . the "test" of actual performance . . . on the job . . . day-in and day-out.

Piping fabricated in Grinnell shops is done under ideal conditions, with modern equipment, by personnel qualified for each class of work. Included in the price (which is determined in advance) are such items of expense as: interpretive engineering, shop sketches and planning, procurement of materials, power services, expendable tools and supplies. There are no charges for waste material or spoilage. All piping is rigidly inspected and tested to comply exactly with customer specifications and applicable codes. Consult Grinnell on your next piping job.

GRINNELL

WHENEVER PIPING IS INVOLVED

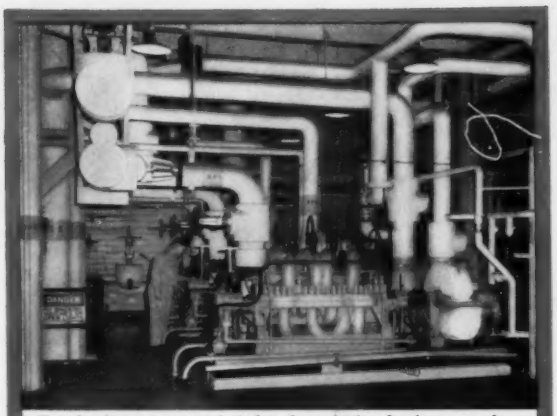
Grinnell Company, Inc., Providence, Rhode Island • Coast-to-Coast Network of Branch Warehouses and Distributors

pipe and tube fittings • welding fittings • engineered pipe hangers and supports • Thermolier unit heaters • valves
Grinnell-Saunders diaphragm valves • pipe • prefabricated piping • plumbing and heating specialties • water works supplies
industrial supplies • Grinnell automatic sprinkler fire protection systems • Amco air conditioning systems

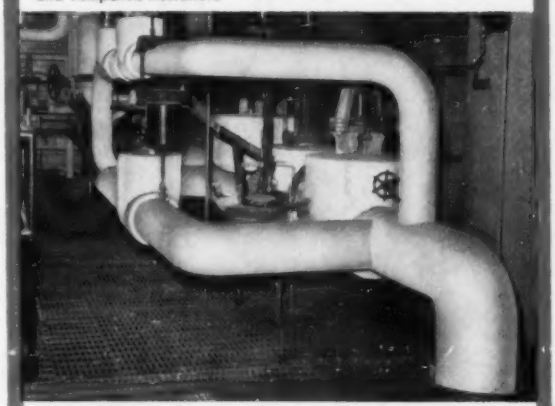
Carey super-light 85% Magnesia and Tempchek help "wrap up" new 20,000 KW Jamestown Plant

Efficiency in every single operation is a must at this plant in order to meet steadily increasing power loads. That's why Carey Super-Light 85% Magnesia and Carey Tempchek were the No. 1 choice for insulating plant boilers and piping throughout the entire new 20,000 KW installation. Fuel economy, maximum thermal efficiency are assured with these time-tested Carey products. They excel in efficiency, strength, workability and light weight . . . stand up under all kinds of humidity, vibration and water conditions . . . save space!

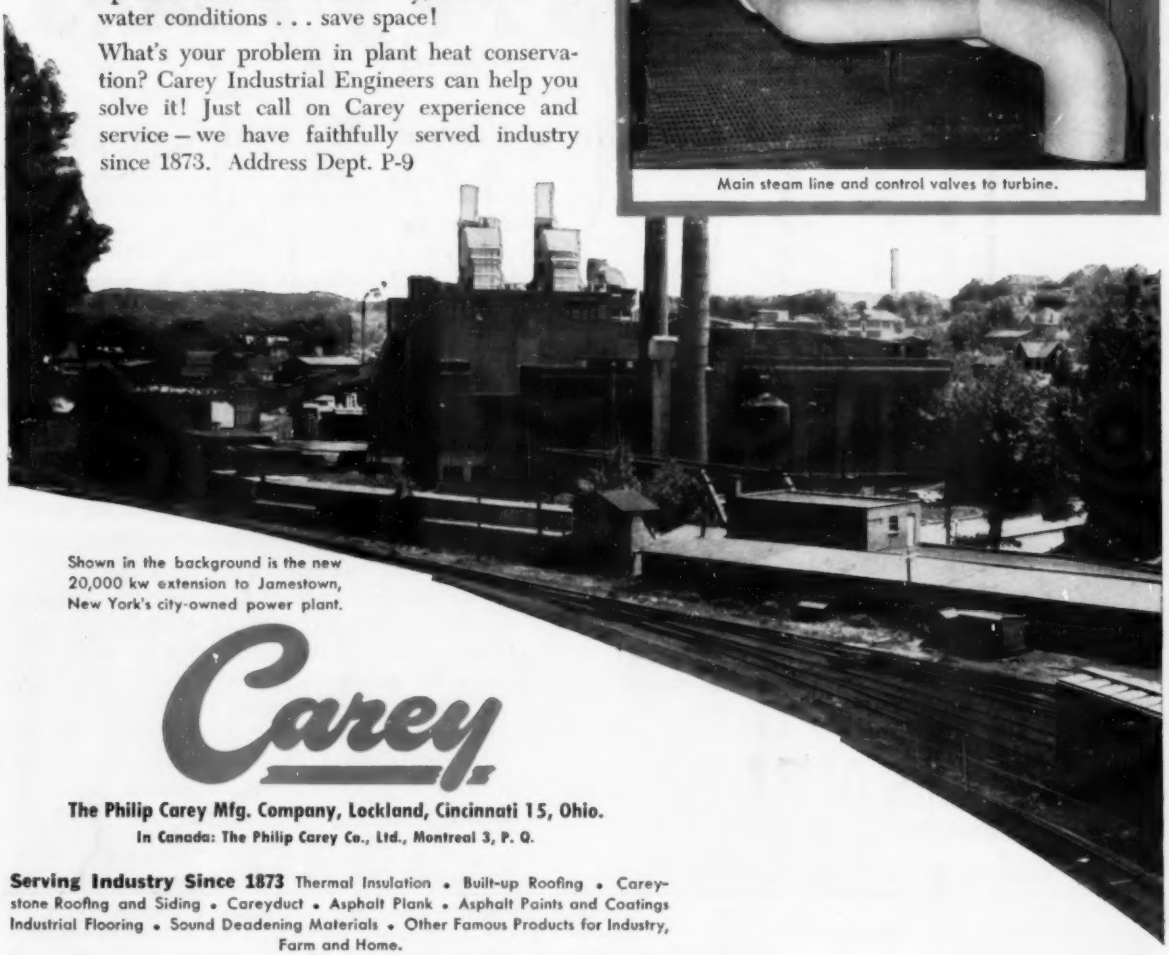
What's your problem in plant heat conservation? Carey Industrial Engineers can help you solve it! Just call on Carey experience and service — we have faithfully served industry since 1873. Address Dept. P-9



The feedwater system includes three boiler feed pumps, four closed stage heaters, one de-aerating heater, and an evaporator. All piping is covered with Carey 85% Super-Light Magnesia and Tempchek insulation.



Main steam line and control valves to turbine.



Shown in the background is the new 20,000 kw extension to Jamestown, New York's city-owned power plant.

Carey

The Philip Carey Mfg. Company, Lockland, Cincinnati 15, Ohio.

In Canada: The Philip Carey Co., Ltd., Montreal 3, P. Q.

Serving Industry Since 1873 Thermal Insulation • Built-up Roofing • Careystone Roofing and Siding • Careyduct • Asphalt Plank • Asphalt Paints and Coatings Industrial Flooring • Sound Deadening Materials • Other Famous Products for Industry, Farm and Home.